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William Bailey.

IT has been the duty of the Committee on Necrology to record, from time to time, the passing of some of the oldest and best loved members of the American Public Health Association; but seldom has its sense of real loss seemed greater than when called upon to chronicle the death of Dr. William Bailey, of Louisville, Ky., who died on July 15, 1911.

Dr. Bailey was born in Bridgeport, Ky., in 1833. He received the degrees of B. A. and M. A. from the Kentucky Military Institute and his medical degree from the Kentucky School of Medicine, subsequently the Hospital School of Medicine, of whose faculty he later became president.

On the outbreak of the Civil War he enlisted on the Union side, becoming surgeon in the Ninth Kentucky Cavalry with the rank of Major. In 1863 he settled in Louisville of which city he remained a resident. At the time of his death he was professor of materia medica, therapeutics, and public hygiene in the University of Louisville.

Dr. Bailey was a member of many organizations, among them several local medical societies, the State Medical Society, the American Medical Association, and the American Public Health Association, and served each of them, with the exception of the American Medical Association, as president. He was a member for many years, and president at the time of his death, of the State Board of Health of Kentucky, which has stood since its inception for the highest ideals in public medicine.

The interest which Dr. Bailey took in the work of the American Public Health Association was shown by the regularity with which he attended its conventions, for he seldom missed a meeting, even during the latter years of his life. To many of the members the opportunity of seeing Dr. Bailey was one of the greatest pleasures of the annual convention. Dr. Bailey was elected president of the Association in 1895. In the many years that he was a member of the Executive Committee, no one was more constant in attendance, or showed more interest in the questions discussed, and no one's opinion was listened to with greater respect.

Dr. Bailey was a man quite beyond the ordinary, not only in those qualities which are the essential attributes of a gentleman, but also in those yet more delicate traits which mark the true physician. He possessed that intellectual refinement which comes from constant intercourse with the best representatives of his profession and from unremitting study. Even in the busiest years of his life he was not too busy to devote three hours a day to reading and study.

"*Vir propositi ingenii* may well be his epitaph, while the historical records of the American Public Health Association will be the richer for having such a name added to the roll of honor of its departed members, who, though dead, speak.

To Mrs. Bailey and her family the sympathy of every member of the Association is extended.

PETER H. BRYCE.

EDITORIALS

THE CHOLERA SITUATION.

CHOLERA has been present for several years in Russia during the summer, autumn, and early winter. Occasional limited outbreaks have occurred in other countries of Europe, the source of infection usually being traced to Russia.

During August, 1910, cholera appeared in several localities in Italy, and continued to be present up to January 30th of the present year. No further cases were reported until June 8th, since which date the disease has prevailed in many localities in Southern Italy, among which are the ports of Naples and Palermo, the latter being in Sicily. The presence of the disease in Italy has been, and is, of special importance to the United States because of the large number of immigrants who come from there to this country, most of whom sail from the ports named. Between June 8th and August 12th of this year, there have been reported in Italy 5,591 cases and 2,199 deaths.

On June 13th the steamship Berlin arrived at New York from Italian ports with the history of having had a death at sea from cholera. On the following day the Europa arrived at New York Quarantine with a case of cholera aboard, and on June 20th the Duca Degli Arbuzzi arrived with four cases. Other vessels also arrived with cases of cholera, or cholera carriers.

The occurrence of these cases among passengers who had been detained under observation for a period of five days before embarkation indicated that cholera carriers were becoming an important factor. Cholera bacillus carriers are individuals who carry the vibrio of cholera in their intestinal tracts, or probably at times in the gall bladder, and yet exhibit no clinical symptoms of the disease. Persons who have had the disease and recovered may continue to be carriers for days or weeks, others may be carriers for a short period before developing clinical symptoms, and still others, who have been in direct or indirect contact with the sick or with other carriers, may become carriers for varying periods without being ill at any time. In places where cholera is epidemic there will usually be found a number of healthy carriers. Passed Assistant Surgeon McLaughlin found six to seven per cent of carriers among healthy individuals living in the infected neighborhoods in Manila. The cholera carrier is undoubtedly a much more potent factor in the spread of the disease from one locality to another than are actual cases of the disease. The sick are readily detected and

isolated, but the detection of healthy carriers is a far more difficult problem and requires a careful and painstaking bacteriological examination, which usually takes at least two days to complete.

In compliance with the United States Quarantine regulations, persons coming from cholera infected localities are detained under observation for a period of five days before being allowed to embark at foreign ports. On account of the continued prevalence and spread of the disease in Italy the United States consuls at all Italian ports have been directed to hold all steerage passengers five days, no matter from what section of Italy. They are not allowed to take foodstuffs on board.

These precautions have apparently blocked all avenues by which the disease could be brought to this country with the possible exception of the cholera carrier, to eliminate whom an addition was made to the quarantine regulations July 19, 1911, requiring that all steerage passengers arriving at United States ports from ports or places infected with cholera shall be subjected to a bacteriological examination, and shall not be admitted to entry until it has been determined by said examination that they are not cholera bacillus carriers. This regulation was put immediately into force, and experienced officers were detailed to those ports where the maritime quarantine is not in charge of officers of the Public Health and Marine Hospital Service, but which are, nevertheless, subject to the Treasury Department regulations, and at which immigrants arrive from infected territory.

The bacteriological examination of every steerage passenger from an infected port or place at first seemed too great an undertaking to be practicable, but it has been and is being successfully done. Thus at Boston, the steamship Canopic arrived August 8th, with 297 second cabin and 896 steerage passengers, a total of 1193, and their examinations were concluded in fifty-four hours. Ten expert assistants had been specially trained for the work. In New York, some ten or fifteen bacteriologists, including those regularly attached to the quarantine station, those detailed from the State Department of Health at Albany and one from the Public Health and Marine Hospital Service, are successfully engaged in this work, aided also by the laboratory of the Health Department of the city of New York. This is a notable advance in scientific maritime quarantine.

Similar restrictions were placed by the Canadian government July 27th on steerage passengers coming from Italy either directly or via intermediate ports. This makes it impossible for immigrants to enter the United States by way of Canada without undergoing a bacteriological examination.

In spite of all the enumerated precautions, there is a possibility of the admission of an immigrant cholera carrier. In order that a case may be discovered early, should such an event occur, the state health officers are notified of all immigrants destined to their respective states. It is important that the state and local health authorities exercise a surveillance over these immigrants for the prompt detection and examination of cases simulating cholera, the most important factor in preventing the spread of the disease being the recognition of cases as near the time of onset as possible, and especially the mild and atypical cases.

For the purpose of furnishing aid for rapid diagnosis and the prompt institution of suppressive measures should cholera carriers or cases be suspected or found, the Service has stationed officers, who are available for duty within a practical radius of their stations, at the following named ports: New York, Boston, Washington, D. C., Chicago, San Francisco, New Orleans, and Savannah.

The Bureau has also published and widely distributed a pamphlet on "Cholera: Its Nature, Detection and Prevention," prepared by Passed Assistant Surgeon McLaughlin, who was in charge of the successful measures in stamping out an epidemic in Manila in 1908. This pamphlet contains a full account of the history, etiology, pathology, symptomatology, bacteriological diagnosis and preventive measures necessary to be taken immediately upon the discovery of a case.

So far the only cases of cholera which have been reported as developing in the United States outside of quarantine are the following:

One case developed in Auburn, N. Y., in the person of an immigrant who had been detained in quarantine seven days, and at Ellis Island one day. This case was not verified bacteriologically.

One case developed in Brooklyn, in an immigrant who had been detained at quarantine seven days. Upon diagnosis this case was returned to quarantine.

One case developed on Staten Island, in an employee who had previously been guarding the apparently well at quarantine. After falling ill he was returned to quarantine.

One case developed in New York, in a Spaniard who had arrived on a steamship from South American and West Indian ports. This case likewise was taken to quarantine.

One case developed in Boston, in an Italian woman. She was removed to Gallop's Island quarantine, where she died July 20th. The diagnosis of cholera was later verified bacteriologically.

It should be further stated that the steamship companies represented in the Transatlantic Passenger Conferences have agreed to co-operate by

endeavoring to restrict emigration as far as possible from infected places, and there has already been curtailment in the sailings from Mediterranean ports.

In Russia the disease, which was so virulent during the last summer and fall (about two hundred thousand cases and about one hundred thousand deaths being reported) disappeared in the late winter, but reappeared to a limited extent in the spring, and now appears to be on the increase in several of the "governments," though it has not yet reached the proportions of a great epidemic.

It is believed that with all health authorities, national, state and local, alive to the importance of the situation, there should be little likelihood of the disease gaining a foothold in any locality.

WALTER WYMAN, *Surgeon-General*,
Public Health and Marine Hospital Service.

THE CHOLERA SITUATION.

THE aspect of the cholera question has undergone a change in recent years by reason of a better knowledge of its cause and prevention. Bacteriological methods afford an immense advance in the accuracy of diagnosis and a very great security against any careless treatment of a first case, from which the disease might spread. In the treatment of a cholera outbreak, instead of the great energies which were formerly employed on curative efforts and inefficient preventive measures, it is now recognized that the great object, as in typhoid, is the immediate and total destruction of the patient's excreta, and that effective attention to this single duty would be a sufficient preventive of the spread of the disease. In other words, there seems to be no reason why a case of cholera might not be treated, with perfect safety to others, in a hospital ward where patients with other diseases were confined.

The opportunities for the spread of the disease are greater than formerly, because of our increased transportation facilities, but this is more than offset by our improved knowledge and equipment in handling the disease. Today we need not expect a prevalence of cholera or even a serious condition from it, anywhere in a civilized country. It is not likely, with the sanitary equipment of our modern cities and with the present intelligence of the medical profession and of the laity, that cholera will again prevail or spread as it formerly did. It is, of course, our duty to see that this disease does not procure a foothold in this country, and this is a much easier proposition than that of eradicating it should it become established.

In times, such as the present, when cholera exists in foreign ports, we look to the officials on guard there as well as those at our own ports of entry, to observe those precautionary measures which science and experience have demonstrated to be effectual. The United States has a few representatives in foreign ports to safeguard our interests by inspection, and by detention if necessary, of immigrants before departure, but these officials are not in sufficient number to render their inspection a satisfactory guarantee of safety.

If we would prevent risks in the easiest way, it would be by strengthening this inspection and detention at the port of departure. Were it possible to sufficiently detain and to examine bacteriologically every person before departure from an infected foreign port, we might absolutely prevent the transfer of cholera to this country. Such bacteriological tests,

for instance, as were recently and rightly required at our ports by the U. S. Public Health and Marine Hospital Service should be made abroad before departure of the vessel. Such a passenger list, free from cholera as shown by bacteriological tests made before departure, with more than five days en route and with no suspicious sickness on board, would require but little examination and need cause no anxiety at the port of entry. In the event of this bacteriological work not being done at the port of departure, inspection there is but an aid, a partial security, and in such cases rigid inspection and detention at the port of entry for all cases coming from infected or doubtful districts must be required. Of the two systems, greater benefit could be found in the complete work at the port of departure, and it is much better to make this complete inspection, leaving but a casual observation at the port of entry.

During the present outbreak of cholera in various foreign ports, the Boston officials have carefully carried out the recently added requirements in detention and bacteriological work. The single case of cholera found in this city was quickly removed and quarantined on suspicion as soon as discovered, and immediate and stringent precautions were taken. No cases developed among those exposed, and all danger of such cases is now long past. The S. S. Cymric from Liverpool arrived in this port July 27th with 139 steerage passengers from Russia, Turkey, and Syria. These immigrants were detained for bacteriological examination but none were found to be carriers. The S. S. Canopic from Naples, Italy, and the Azores, arrived August 8th with 1198 passengers from the former and 490 from the latter. All in the second and third class from Italy were detained and examined bacteriologically and were found negative.

With the present guard maintained here as a port of entry, the risk of importation of cholera is very small. Extreme measures at any port of entry for vessels should be avoided, since we are readily able in our present stage of advanced knowledge to detect and remove single cases of cholera. Only strictly scientific measures should be used in the treatment of this subject and all unnecessary obstruction to commerce should be avoided.

S. H. Durgin, M. D.,
Chairman, Boston Board of Health.

SPECIAL ARTICLES

THE BACTERIOLOGICAL EXAMINATION OF FECES FOR VIBRIO CHOLERAE.*

By A. M. STIMSON,
Passed Assistant Surgeon, Public Health and Marine-Hospital Service.

Asiatic cholera is a disease of short incubation, the majority of cases coming down with marked symptoms within a couple of days of exposure, and a very few cases after as long as five days. It would seem, therefore, that the ordinary detention period of five days for ships from infected ports, together with the period of observation during the long sea voyage, should offer adequate protection against the introduction of cholera into the United States. Unfortunately, however, it is a fact that numbers of people in cholera-ridden districts become carriers of virulent vibrios without exhibiting any symptoms which would lead to their detection. Some of these persons have recovered from mild attacks of cholera, either recognized as such or dismissed with a diagnosis of diarrhea, gastro-enteritis, etc., while others have had absolutely no recent illness so far as can be determined. To meet the danger offered by these carriers, the quarantine regulations of the Public Health and Marine Hospital Service have been modified so that a bacteriological examination must be made of all steerage passengers from infected ports. These measures undoubtedly tend to minimize the introduction of carriers, but it can hardly be claimed that they are competent to absolutely prevent it, for the reason that a single examination might not detect intermittent carriers. It would not be surprising, therefore, if isolated cases of cholera were to develop among recently arrived immigrants, or in those directly or indirectly associated with them, and lead to serious results if not detected in time.

For this reason it is deemed opportune to outline a method for the examination of suspected cholera cases or carriers which it is believed will be efficient in demonstrating the vibrio if it is present, while being as saving of time and labor as is compatible with thoroughness. It must be pointed out, however, that in all probability cholera carriers sometimes

*From the Hygienic Laboratory, U.S. Public Health and Marine-Hospital Service.

pass feces which are free from the vibrio, in other words, that their emission of the germs is intermittent. Several successive negative results would therefore be necessary to give absolute security, though a reasonably complete elimination of carriers could be secured by a single thorough examination.

SECURING THE SPECIMEN.—It is necessary that specimens should be reasonably fresh, otherwise when vibrios are few in proportion to other bacteria they will be outgrown, and their detection rendered difficult or impossible. Again the specimen should be sufficient in amount. While the routine examination of the amount of feces adhering to a rectal swab after it is drawn through a tight sphincter is undoubtedly capable of demonstrating a proportion of carriers, the writer believes that this method is inadequate, and might be disastrous in giving a false sense of security. It is recommended, therefore, that the specimen be taken from a fresh stool which has been received into a clean receptacle and untreated with disinfectants. This last point would seem superfluous to mention were it not that, especially in hospitals, it is sometimes necessary to instruct nurses or orderlies to omit the routine addition of disinfectants to bed pans. The writer ventures to suggest a method of securing specimens where persons are being examined on a large scale (e. g., at quarantine), which method he has not tried, or seen tried, but which appears to him to have advantages. This plan is to receive the dejecta into a wooden receptacle such as small quantities of butter are retailed in, this butter dish or cup being placed in the bottom of a chamber pot or bed pan which could be treated with a liquid disinfectant after removal of the specimen. In this way the feces would be protected from the action of the disinfectant, while the time-consuming disinfection of the chamber pot by boiling water or steam would be avoided.

Where there is a difficulty in obtaining specimens of feces because of constipation, a high enema of sterile water would be preferable to the use of aperients. Or the material collected in the eye of a long rectal tube may be utilized. The use of aperients is apparently not free from danger, since in one case—a carrier without symptoms—a fatal infection was apparently induced by the local lowering of resistance caused by the administration of calomel and salts.

Material from autopsies should be taken from several portions of the small intestine, or loops a few inches long may be tied off, excised, and placed in jars until specimens can be taken. The vomitus is said to contain the vibrio sometimes, but a negative report should never be based on the findings in this material alone.

PLANTING THE MATERIAL.—It is advisable that the material be planted in culture media as early as possible. Where many specimens are being examined, a laboratory attendant can do this at the hospital, detention barracks, or on ship-board. Where difficulties in the transportation of fluid media exist, the material can be taken up on a short flat stick (half of a wooden tongue depressor) and dropped into a sterile bottle or tube, or, if fluid, placed therein by means of a sterile spoon or pipette, and carried in this way to the laboratory. This extra handling involves considerable danger of infection and takes more time and labor. The first planting, in the writer's opinion, should always include the sowing of about 1 gm. (1 c. c.) of feces in a flask containing 100 c. c. of peptone solution, (1% peptone, 0.5% NaCl, neutral to phenolphthalein). In making a diagnosis where cholera is suspected, time may be saved by making plates directly from the stools, but this can hardly be done outside of the laboratory, and is not worth the extra time and trouble of the manipulation in searching for carriers. Flasks of peptone solution could, in many situations, be taken to the detention barracks or bedside, and there inoculated directly from the fresh specimen, an improvised carrying case made from a suit case, or box with racks to keep the flasks from breaking, being used for transporting them.

INCUBATION.—Where plates have been made directly from the stools, they should be incubated 18–24 hours and examined for characteristic or suspicious looking colonies (see below) which may then be tested for agglutination.

The flasks on the other hand, should be examined after about six hours incubation, and again after 12 and 24 hours incubation. The reason for the repeated examinations is that, depending on the nature and number of other micro-organisms, the cholera vibrios may be relatively more numerous and viable at various periods. It is generally believed that this organism grows more rapidly than other vibrios in peptone solution, hence the six hour examination. If very few in numbers and relatively pure in culture, the longer period of incubation would be more likely to detect them.

EXAMINATION OF FLASKS.—The writer is aware that at this point it is customary for many workers to make hanging-drop and smear preparations from the upper layer of the peptone culture, in order to determine the presence or absence of motile vibrios; but he regards the procedure as ordinarily too unreliable to justify the great amount of time involved where there are many specimens to be examined. The objections to it are, that where vibrios are relatively scanty they may readily be missed

in the hanging-drop; that stained preparations from peptone cultures are apt to be poor, owing to deposits of stain and massing of bacteria from the pellicle; and finally, that the procedure is superfluous, since a pure plate culture must be obtained by plating in any case before a positive diagnosis can be made, and vibrios in sufficient numbers to be detected in this manner would also be found among the plate colonies.

Where one is not pressed for time and desires to satisfy his curiosity as to the microscopic appearance of the growth, he should proceed as follows: tilt the flask, without agitating it, until the pellicle, if present, separates from one side of the flask, and then take the loops of culture from the clear surface thus exposed. In examining for motility, look at all parts of the hanging-drop, and at all depths, and tune the eye to catch an exceeding rapid darting motion, for this motion has sometimes been missed by those fairly well accustomed to the ordinary uses of the microscope. Stain the dried and fixed specimen with cold carbol-fuchsin (diluted ten times) and look for slightly bent rods. Most text-book illustrations show a more pronounced curve than does the average cholera bacillus, which is often hardly more than straight on one side and rounded on the other. Atypical morphology (involution forms, coccoid forms, short plump rods) while common in old cultures, appear to occur very seldom in freshly isolated young cultures.

The essential part of examining the flasks is therefore simply:

Plating the Peptone Culture.—Many plate media have been devised and used, which were designed to facilitate the demonstration of cholera vibrios by favoring their growth and restraining the growth of other organisms, notably *B. coli*, and also by permitting the cholera vibrio to build a colony of characteristic appearance. It is too much to say that these media are all worthless, but it is true that they are unnecessary.

The medium advocated by Dieudonne is perhaps the best of these, but its preparation is much more difficult than that of plain agar, requires a large supply of defibrinated beef blood, and takes up much space and time in drying. Plain nutrient agar (2% to 3% agar for firmness of medium, in ordinary nutrient bouillon, rendered neutral to phenolphthalein), answers every practical purpose, if enough well-made plates are available to give a large number of discrete colonies. The plates should first be poured, the surface dried for an hour or so in the incubator, and the peptone culture then stroked over the surface to produce surface colonies, which alone are of use. For smearing purposes a piece of $\frac{1}{16}$ inch glass rod, bent nearly to a right angle, is recommended. The short area should be

about 1½ inches and the long area 4 or 5 inches in length. This is conveniently used by loading the outer side of the short arm with one loopful of the surface peptone culture, and stroking the wet portion over the surfaces of successive plates. Where the ordinary sized Petri dishes are used, three will be necessary for those unexperienced in this method, in order to be sure of getting a good distribution of colonies. The large (18 cm.) plates offer a larger surface for colonies with fewer pieces of glassware to wash and sterilize.

The plates thus made are incubated at 35-36 degrees C., for not less than 16 hours, in order to allow the colonies to become large enough to be distinctive in appearance and furnish ample material for a preliminary agglutination test. This is also necessary since it is known that some strains of cholera vibrios are subject to isoagglutination in salt solution or normal serum when the growth is very young.

Examining the Plates.—If the second or third plate of a series should not give plenty of discrete colonies, replating is necessary to secure this result. The cholera colony is stated to have a characteristic appearance on agar, but there are other vibrios which form indistinguishable colonies, and various bacteria may form colonies which may excite suspicion and which must be therefore subjected to examination. In its typical form the cholera colony is round or slightly irregular in outline, is translucent, and on observation by transmitted light at various angles is opalescent, frequently showing an iridescent play of delicate tints. Control plates of a known cholera vibrio should be employed at first and various types of colonies examined until the bacteriologist is assured of his ability to recognize vibrio colonies.

Suspected colonies on the plates may at once be subjected to a preliminary agglutination test, first marking their position on the plate so that they can be again referred to, if necessary, for further examination. For this purpose it is suggested that small triangular pieces of gummed label bearing a number be pasted on the under side of the dish so that the acute angle points to the corresponding colony. Wax pencil marks are apt to be obscured or obliterated and lead to confusion.

Agglutination Tests.—The mainstay of the diagnosis of cholera is the bacteriological examination; the mainstay of this examination is the agglutination test to which all other procedures are but preliminary. In cases where the clinical picture arouses suspicion of cholera, and plates have been made directly from the stools, the colonies which develop may be examined after at least 16 hours incubation. There are several variations in the technique of applying this preliminary test, which consists

essentially of emulsifying a small portion of a colony picked up on a platinum needle in a drop of specific agglutinating serum dilution, and a similar portion in a drop of salt solution to act as a negative control. A positive control with known cholera vibrios should be made from time to time. Agglutination may then be observed with the naked eye if cholera organisms are present. To prevent too rapid drying of the drop the test is conviently made on a cell slide, the cell being protected by a coverglass sealed with vaseline. The dilutions used will depend upon the titre of the specific serum, but should be at least 1-200. This preliminary agglutination is quite sufficient for diagnostic purposes in public health work, but colonies so agglutinated should be fished to agar slants, and after 18 or more hours of incubation subjected to an accurate quantitative test to determine the maximum titre of agglutinability. This is conveniently carried out by emulsifying one standard loopful (approximately 2 mg.) of agar culture in each of a series of small tubes containing 1 c. c. of progressively increasing dilutions of the specific serum in salt solution. Control series should be made at the same time, one of known cholera vibrios in serum dilutions, and one of the suspected culture in plain salt solution, or preferably corresponding dilutions of the serum of a normal animal of the same species as that from which the specific serum was prepared. All cholera vibrios give agglutination with specific serum at or near the maximum titre. Other organisms do not. The tubes are placed in the thermostat and observed with the naked eye at intervals up to two hours. At this point, also, the motility of the organism may be observed in hanging-drop, and its morphology in a stained smear, or dried hanging-drop.

Health officers and others who may be called upon to undertake cholera examinations would do well to secure in advance a supply of reliable serum, as it is indispensable for accurate diagnosis and may not be readily obtained in emergency. Any bacteriologist having an authentic cholera culture can prepare such a serum from rabbits in the course of three or four weeks.

In this description no reference has been made to many characteristics of the cholera vibrio, cultural and otherwise, upon which text-book articles will furnish extensive information and perhaps lay some stress, for the reason that they are regarded by the writer as of more scientific than practical interest, the agglutination test being the criterion for identification of the organism.

The method recommended is in brief:

1. (a) In suspected CASES prepare plates directly from the feces and also employ step (b).

(b) In searching for CARRIERS plant 1 c. c. (1 gm.) of feces in 100 c. c. peptone solution.

2. Incubate 6 hours and prepare plates.
   Continue incubation 6 hours and prepare plates.
   Continue incubation 12 hours and prepare plates.
3. Incubate plates 16 or more hours.
4. Examine suspected colonies by preliminary agglutination test, and observe morphology and motility of those responding.
5. Plant colonies which agglutinate on agar slants and incubate 16 or more hours.
6. Make quantitative agglutination test of slant growths.

FOOTNOTE.—Since writing the above article the writer has had an opportunity to discuss methods with P. A. Surgeon McLaughlin, U. S. P. H. & M. H. S., who has had large experience with the bacteriological methods used in cholera cases in the Philippines, and recently in connection with the examination of immigrants in New England. Dr. McLaughlin favors the preliminary examination of the peptone culture by an extremely careful microscopic scrutiny of smear preparations before making plates, believing that a negative result justifies the exclusion of the specimen from further examination. The writer desires to express his entire confidence in this method when such skill as Dr. McLaughlin and his co-workers were able to bring to bear upon the work is available, and admits that much labor is spared by this method. However, when even good bacteriologists who have had little or no experience with cholera are suddenly confronted with the problem, with no opportunity to orient themselves in this particular work, it is believed that a smaller margin of error will be permitted in following the method described in this article.

A BACTERIOLOGICAL INVESTIGATION OF COMMERCIAL ICE CREAM IN THE CITY OF BOSTON.

By EDITH A. BECKLER and DELPHINE J. DUSOSSOIT.
(From the Biological Laboratories of Simmons College.)

Among the regulations for the manufacture, sale, and care of ice cream established* by the Board of Health of the City of Boston, Article IV, Section 2, reads as follows:

"No person, by himself or by his servant or agent, or as the servant or agent of any other person, firm, or corporation, shall in the City of Boston, sell, exchange, or deliver, any ice cream which contains more than 500,000 bacteria per cubic centimeter."

As investigations carried on in the District of Columbia by Dr. George W. Stiles and in Philadelphia by Dr. M. E. Pennington,† showed the average sample to have a bacterial content vastly in excess of 500,000 per cubic centimeter, the following investigation was made to find out whether or not the above mentioned regulation was complied with.

The samples collected were purchased in the open market, usually in half-pint pasteboard cartons; or if bought at soda-fountains, a portion was put into a sterilized glass-stoppered bottle of about 100 cubic centimeters capacity. Within an hour after purchase the samples were taken to the laboratory, and portions, sufficient in amount for bacteriological examination, were removed from the interior with sterile spoons and placed in sterile bottles to melt.

Since large numbers of bacteria were to be expected in a milk product, it was necessary to make high dilutions for the quantitative analysis. The technique used was, in brief, as follows: The melted ice cream was measured in standardized one cubic centimeter pipettes which had previously been sterilized by hot air and kept in bacteria-proof metal cases.

The technique and methods recommended by the Committee on Standard Methods for the Bacterial Examination of Milk, were followed by us in making dilutions, plating and incubating. The agar used was also that recommended by this committee.

In order to determine the presence of gas-producing organisms, one cubic centimeter of the 1:100 dilution was transferred to a fermentation tube containing 2% dextrose broth and incubated at 37° C. for 48 hours. When gas was produced, the amount was measured by the ruled scale method.

* August 4, 1906.
† Hygienic Laboratory Bulletin, No. 56.

This investigation extended from July, 1910, to January, 1911, and during that period 103 samples of commercial ice cream were collected from the manufacturers, department stores, small shops, and drug-stores in Boston. A summary of the numerical results follows:

Samples showing—	
Less than 50,000 bacteria per cubic centimeter	0
From 50,000 to 100,000 bacteria per cubic centimeter	0
" 100,000 to 150,000 " " " "	0
" 150,000 to 200,000 " " " "	3
" 200,000 to 300,000 " " " "	3
" 300,000 to 500,000 " " " "	6
" 500,000 to 750,000 " " " "	5
" 750,000 to 1,000,000 " " " "	7
" 1,000,000 to 2,000,000 " " " "	11
" 2,000,000 to 5,000,000 " " " "	24
" 5,000,000 to 10,000,000 " " " "	22
" 10,000,000 to 25,000,000 " " " "	16
" 25,000,000 to 50,000,000 " " " "	3
" 50,000,000 to 100,000,000 " " " "	3
Above 100,000,000 " " " "	0

The average number of organisms per cubic centimeter was 7,993,721. The maximum count obtained was 97,000,000, and the minimum 150,000 per cubic centimeter. Of the total number of samples, 19.8% showed the presence of gas-producing organisms when 2% dextrose broth was inoculated with 0.01 cubic centimeter of the sample.

The presence or absence of streptococci was also investigated in all of the samples. Attempts were made, by centrifugalization, to secure a sediment which could be satisfactorily stained, but this method was soon abandoned on account of the debris obtained. It was usually possible to recognize colonies of streptococci on the plates, and when inoculated into bouillon, these developed into long or short chain streptococci. 82% of the samples of ice cream showed the presence of streptococci, and in the majority they were apparently present in pure culture.

During the course of this investigation it was thought advisable to find out whether or not ice cream could be made which would have a bacterial content within the legal limit. For this purpose cream, purchased from several dealers, was sweetened, flavored with vanilla, and frozen in a small freezer which had previously been scalded with boiling water. The ice cream was packed in the usual salt and ice mixture and allowed to stand for two hours, after which a portion was removed for analysis. The results were as follows:

	Bacteria per cubic centimeter
Sample 1:	
Cream	2,000,000
Ice Cream	3,500,000
Sample 2:	
Cream	3,800,000
Ice Cream	2,300,000
Sample 3:	
Cream	4,000,000
Ice Cream	1,300,000
Sample 4:	
Cream	990,000
Ice Cream	480,000

Samples 3 and 4 were kept frozen at a temperature varying from —10 C. to —20 C. for 12 days, portions being removed for analysis every 24 hours from sample 3 and every 48 hours from sample 4. The results are tabulated below:

SAMPLE 3.

	Bacteria per cubic centimeter		Bacteria per cubic centimeter
Fresh ice cream	1,300,000	After 6 days	510,000
After 1 day	820,000	" 7 "	1,000,000
" 2 days	1,200,000	" 8 "	2,200,000
" 3 "	990,000	" 9 "	4,100,000
" 4 "	960,000	" 10 "	25,000,000
" 5 "	800,000	" 11 "	37,000,000

SAMPLE 4.

Fresh ice cream	480,000	After 8 days	4,200,000
After 2 days	520,000	" 10 "	2,500,000
" 4 "	330,000	" 12 "	1,800,000
" 6 "	3,000,000		

Ice cream may be kept by the manufacturer, or more often by the retail dealer, for several days, and the possibility of changes in the bacterial flora during that period ought to be considered. Doctors Stiles and Pennington, in their investigations upon changes in ice cream during storage, found that although there was considerable variation in the behavior of different samples, there was often a pronounced increase in the numbers of bacteria.

The cream is obviously the source of the majority of the bacteria found in ice cream. During the course of this investigation 41 samples of cream were analyzed bacteriologically. The results were as follows:

Samples showing:			
Less than 10,000	bacteria per cubic centimeter		0
From 10,000 to 50,000	" " " "		4
" 50,000 to 500,000	" " " "		4
" 500,000 to 1,000,000	" " " "		
" 1,000,000 to 2,000,000	" " " "		5
" 2,000,000 to 5,000,000	" " " "		12
" 5,000,000 to 10,000,000	" " " "		3
" 10,000,000 to 30,000,000	" " " "		9
Above 30,000,000	" " " "		0

The average number of organisms per cubic centimeter was 5,553,170. The maximum count was 26,400,000 and the minimum 10,000 per cubic centimeter. Thirty of the samples were examined for the presence of gas-producing organisms. Of this number 19, or 63% gave positive results. Streptococci were found in 30 of the samples, or 73% of the total number.

It is a well-known fact that gastro-intestinal diseases are not infrequently traced to the eating of ice cream.* During the summer of 1910 the Women's Municipal League of Boston, through its Committee

*Hygienic Laboratory Bulletin, No. 56.

on Ice Cream and Butter, conducted an investigation of the manufacture of ice cream. The committee worked in conjunction with the clinics at the Infants' and Children's Hospitals, and when cases of illness, probably caused by ice cream, were reported, the place of purchase was investigated. An inspection of the premises often showed very dirty conditions, but several places, on second inspection, showed marked improvement. The Board of Health is assisting the committee by printing, in various languages, the regulations for the manufacture, sale, and care of ice cream.

GENERAL CONCLUSIONS.

The bacteriological examination of ice cream in the city of Boston shows that much of it contains more than 500,000 bacteria per cubic centimeter—the legal maximum. This is due partly to the large bacterial flora of the cream used, to long storage of the product, and in some cases to unsanitary methods of manufacture.

Our analysis of samples of cream indicate that even the careful manufacturer, unless he has an exceptionally good cream supply or depends upon pasteurization, cannot expect to produce ice cream with a bacterial content within the legal limit.

[We wish to acknowledge the valuable assistance which we have received on the preparation of this paper from Mrs. Charlotte Barrell Ware, of the Wareland Dairy School.]

American Public Health Association

THE RELATION OF UNIVERSITIES TO PUBLIC HEALTH WORK.*

By H. W. HILL, M. D., D. P. H.,
Director, Division of Epidemiology, Minnesota State Board of Health.

This subject originally was to be treated in the form of a symposium, by three university presidents and three state board of health representatives. The university men approached failed to accept, and the President turned the whole matter over to me. Finding the time too short and the date of meeting inauspicious for securing papers from those universities, i. e., of the middle and western states, from whom we had hoped most, I believed it best to throw the whole matter open to general discussion by asking representatives of several state boards who have university connections to open the discussion.

Frankness and publicity will cure most ills and promote most good ends. The acuteness of the situation in some states suggests the need of the true relationships which should exist. I wish merely to outline the basis upon which the relationships are sometimes urged or established, leaving it for others to comment, if they choose, on the reality or otherwise of these claims. My main point is this:—To ask that this Association appoint a committee of thoroughly representative men to consider this subject fully in all its aspects and to report the basic principles upon which such relationships may be established—perhaps even to present a model contract which may be adopted or adapted by universities and state boards of health in seeking alliance with each other.

I do not believe that this is a matter which an individual state board of health can consider an affair wholly peculiar to itself, or concerning which it can in any way resent interest in the arrangements made.

The state boards are bodies few in number but immensely influential. They have among themselves common interests and inter-relations still more common. The tendency has been to unify methods and to secure coöperation between them. In unity is strength, and a board which follows a course approved, or already adopted by other boards in conference, is treading on very dependable ground. Universities also, it may be assumed, are bodies of high intelligence and high purpose. It is difficult to imagine any university unwilling to accept a fair and logical arrangement, based upon legal requirements as well as upon justice and efficiency.

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

It is the university which usually seeks the alliance, and the university should find the state boards ready with equitable and enforceable propositions, not with mere verbal or temporary agreements, drawn up at random to suit the individuals concerned at the moment. Permanency can only be secured on a basis of logical and legal arrangements which provides as far as possible, in its principles at least, for the future as well as for the present.

The alliances heretofore made have most commonly taken the form of securing for the state board of health a laboratory location, and facilities or men from the university medical school, in part or in whole. The relative finances of the state boards of health and of the university are usually such that the pooling of salaries, the saving of rent, and sometimes the saving of equipment, appeal to the state board of health as economies; while the university counts on getting its money's worth in the presence of the state board of health's laboratory on the campus, the hope of the educational effect of its presence on students, and the hope of securing abundant material for university teaching purposes from the laboratory. The coöperative idea is also a strong one. The state board hopes to secure a certain amount of help, advice, support, or even prestige from its university connections. The university hopes to be able to show its labors in connection with the state board of health as an example of the practical character of its work, outside of and in addition to the teaching of students. Mutually, both bodies hope that the alliance will prove of value in securing legislative support and impressing the alumni, especially the medical alumni, with the advances which have been achieved.

Beyond laboratory alliances, attempts have been made to secure coöperation in engineering and in epidemiological fields. To the overworked and short-handed state board, visions appear of troops of well-trained, energetic young students, both medical and engineering, flocking out under the guidance of their professors, at the emergency call of the state boards, to investigate epidemics of typhoid fever or problems in sewage disposal or water supply. To the university man, weary of book teaching and anxious to demonstrate to his students what an epidemic is, and how to handle it in practice, or how to solve actual water supply problems on the ground, rather than paper problems in the classroom, the same vision appears, although with a very different aspect and meaning.

It is with the disillusions as well as with the realizations, the failures as well as the successes, the incongruities as well as the symmetries, the impossibilities as well as the inherent necessities of such alliances, that this discussion is to deal.

There are adjustments, not only financial, educational, and coöperative, but dependent on the different legal and governmental status of the two bodies, their facilities in men and authority as well as in buildings and equipment, the execution each of its own proper duties as well as the sharing of the burdens each of the other. That truly successful, really helpful, mutual coöperation may, should, and even must exist, if we are to get the best out of both for the future of public health is, I think, beyond question.

But the *modus operandi* must be determined, and the proper adjustments reached, otherwise the whole structure will come down in a dust of misunderstanding which will make it appear to outsiders that scientific progress meets obstacles from its own professed leaders as great or greater than from its traditional difficulties in other lines. Such failures are the more pitiable because both parties must be credited with high ambitions for the progress of the public good, and the failures to attain depend, in my judgment at least, not on mistakes in the objects sought, but in the lack of clearly defined principles in seeking them.

Each must first perform its proper duties in its own sphere before reaching out to aid the other. Always there must be the line drawn between what must be done to fulfill each its own functions, and what may be done by coöperation to aid in general progress. The state board is an arm of the government; it exercises some of the police powers of the state; it has certain very definite responsibilities and obligations which it can share with no one ethically, legally, or practically. The university is a teaching body under the control of the state; its responsibilities cease with the proper education of its students, however broadly "proper education" may and should be interpreted. It would seem well to determine, first of all, what is the business of each. In doing one's own work, however, it is easier and better to do it so that the work of others may be facilitated, rather than injured or even left in a neutral position. The ultimate ideal is, of course, to reach through thorough efficient work by the various bodies, a co-operation which will make one really co-ordinate system.

THE ADVANTAGES OF CO-OPERATION BETWEEN STATE BOARDS OF HEALTH AND STATE UNIVERSITIES.*

By Prof. E. H. S. BAILEY,
University of Kansas, Lawrence.

In the discussion of a question of this kind I believe all will admit that we are upon untried ground, and that we are here to consider the results of a few experiments that have been made, and to work together for what seems the best policy for the future. It is proper also for us to suggest reasons for our belief or disbelief in the practicability of the plans that are suggested for bringing about this close relation between the universities and boards of health.

The conditions in the State of Kansas are about as follows: In 1905 a law was passed authorizing the State Board of Health to take samples of food and have them analyzed at the Agricultural College and the University, and to publish the results. Practically no appropriation, however, was made to carry out the provisions of this law. Soon after, the State Board of Health, under this law did begin the agitation for better foods, and started the crusade against adulteration and misbranding by having analyses made and published.

Later, when the national pure food and drug law was passed, our previous work paved the way for the passage of the state law, the enforcement of which was placed in the hands of the State Board of Health. The examination of the foods and drugs taken by the inspectors was to be made under the supervision of the directors of the chemical and pharmaceutical laboratories of the State University and the State Agricultural College, which, in this state, are separate institutions. By agreement, different work was assigned to each institution. The state institutions were also authorized to employ sufficient help to do the analytical work expeditiously, so it came properly into the biennial budget of these institutions.

A law was also passed (1907, amended 1909) authorizing that the work of the State Water Survey should be carried on at the State University, under the direction of the State Board of Health. Later, in 1909, a weights and measures law was passed continuing the chancellor of the university as *ex-officio* state sealer, and putting the enforcement of this law in the hands of the State Board of Health.

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

At the present time the secretary of the board is a regular lecturer on foods and drugs in the university and the members of the board are invited to take part as lecturers in a short course offered by the university to city and county health officers. Research work has been carried on in the university laboratories on water supply, purification of water and of sewage, milk supply of cities, food adulterations, and upon special problems such as the cause of infantile paralysis. This work has been done in the chemical, bacteriological, engineering and medical departments of the university. These are the points where the work of the State Board of Health touches that of the State Univeristy.

The reasons that have led to the attempt to secure close co-ordination between the work of the State University and the State Board of Health may be briefly stated as follows:

First: The university should be, as it is rapidly becoming, the intellectual and scientific center of the state. All work of a scientific nature which is done under the direction of the state, should be carried on with the coöperation, to say the least, of the university authorities. This is in accordance with the general tendency, which we cannot resist if we will, to unify and combine all related interests for the better performance of the work as a whole. In accordance with this same principle, that scientific work which particularly relates to the business of the farmer is carried on under the direction of the Agricultural College. On this account we unite here the work of the Agricultural Experiment Station, of the Entomological Commission, the Dairy Commission, and the Forestry Station. The work of the State Geological Survey and of the Fish Commission is done under the direction of university professors.

Second: It has been wisely said that the funds of the state can be much more economically expended if we utilize laboratories that are already built and equipped, libraries that are collected, scientific instruments that are already the property of the state, and a trained corps of men familiar with scientific work, and capable of carrying on research. The construction and equipment of laboratories to carry on work in food analyses, water analysis, bacteriological examinations, and research in various lines, would require the expenditure of considerable money, and much of it, we believe, would be needless. These facilities are already furnished by the universities, and only require enlargement and trained men to do the work to supply the needs of the State Board of Health.

Third: When the scientific work is conducted at the state institutions, those who are working in related lines of investigation are accessible for consultation and advice. There is, in fact, a force of trained men who may together consider the problems.

Fourth: A much larger and more influential class of people in the state will learn of the work of the State Board of Health, and will thus be ready to give it their support. It will, we think, be admitted that much of the work of the board is educational. If this is true, where can we better begin the work of getting near the people than by coöperation with the educational institutions where so many of the sons and daughters of the people are educated?

Fifth: From the standpoint of the student of the university, there will be the opportunity of recognizing that the State Board of Health is one of the great agencies employed for improving the condition of the people of the state. If the State Board of Health is recognized at the university, and some of its work is done there, the student will know enough about it when he returns home, so that he will support the efforts of the board in his own town when they try to enforce the laws for pure food, pure water, and sanitary surroundings.

Sixth: It would seem probable that the closer the relation between the board of health and the educational institutions, the better will be the opportunity for an economical expenditure of the funds of the state. There will be less opportunity for showing favors to political friends, and thus by implication there will be more efficient service.

These, then, are some of the reasons why we believe the experiment ought to succeed. While admitting that, in many of its phases, the work of the State Board of Health must be absolutely distinct from that of the State University, because this board has a certain police power to aid it in protecting the citizens, we do believe that from the broad view of those who want to see the BEST results for the GREATEST NUMBER of the people of the state, there should be maintained the closest possible coöperation that is practicable between these great state institutions.

THE RELATION OF THE STATE UNIVERSITY OF NORTH DAKOTA TO THE STATE BOARD OF HEALTH.*

By Dr. GUSTAV F. RUEDIGER, M. D.,
Director, State Public Health Laboratory, University of North Dakota, Grand Forks, N. D.

We must have a definite ideal before us if we wish to establish the best relations between the State University and the State Board of Health. I believe also that there should be some uniformity in these relations in different states, but we must take into account existing conditions. It is very well to have an ideal before us, but when the existing conditions are such that we cannot attain this ideal we must be satisfied with the nearest possible approach to it.

I shall confine my remarks almost wholly to the relation of the State University to the State Board of Health of North Dakota, as I have given that question a great deal of thought

There is at present practically no relation at all between these two state departments. The state public health laboratory is located at the university; it is controlled by the university, and its funds are in the trust of the board of trustees. The legislative act creating the public health laboratory, which reads as follows, will make clear this relation:

SEC. 1. There is hereby established a Public Health Laboratory. Such laboratory shall be established at the State University and School of Mines; it shall be under the control and regulation of the trustess of the university, and the professor of bacteriology and pathology at the State University shall be the director of said laboratory.

SEC. 2. It shall be the duty of the director of said laboratory to make bacteriological examinations of body secretions and excretions, waters and foods; and make preparations and examinations of pathological tissues submitted by the state superintendent of public health, or by any county superintendent of public health, or by any regularly licensed physician of North Dakota. These analyses and preparations shall be made and the results furnished as expeditiously and promptly as the nature of the work and the equipment of the laboratory permit.

SEC. 3. The board of trustees shall cause to be collected and tabulated such sanitary statistics, and shall cause to be ascertained by research work such methods, as will lead to to the improvement of the sanitation of the various parts of the state.

SEC. 4. It shall be the duty of the said board to cause proper specimens of bacteriological and pathological material, discovered or examined in the work of said laboratory, to be skillfully prepared, secured, labelled, and preserved for public inspection free of cost in the University of North Dakota in rooms convenient of access and properly furnished and in charge of a proper scientific curator.

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

SEC. 5. The director of said laboratory shall cause to be issued from time to time, bulletins and reports setting forth the results of the sanitary and pathological work done in such laboratory. The substance of these bulletins and reports, embodying all useful and important information resulting from the work carried on in such laboratory each year, shall be incorporated in an annual report to the Governor, who shall lay the same before the Legislative Assembly.

SEC. 6. The professor of bacteriology and pathology in the medical college of the State University shall be the director of the public health laboratory and shall be *ex-officio* the state bacteriologist.

The laboratory is under the control and regulation of the trustees of the university and is in no way under the control of the State Board of Health. The laboratory is, however, directed to make bacteriological examinations of material submitted by the state superintendent of public health, and by the county superintendents of public health. Under this clause the State Board of Health can direct the laboratory to make various kinds of bacteriological examinations which have a bearing on the public health of the state. Up to the present time, however, although the laboratory has been in existence for over three years, the State Board of Health, as such, has never directed the laboratory to make any investigations. The individual members of the board, however, are regularly sending material for diagnosis from their private practice.

I believe that the State Board of Health would not lose its prestige if it took advantage of the facilities offered by the laboratory in making investigations for the board. Under the present arrangement the State Board of Health could get due credit for the work thus performed for it by the public health laboratory, and the laboratory also could get its share of credit, because it could incorporate in its annual report to the Governor all reports sent to the State Board of Health.

I do not believe that our present arrangement is particularly disadvantageous to the State Board of Health, although at first glance it may seem so to be. The only change that I would advocate in our arrangement would be a closer affiliation between the public health laboratory at the university and the State Board of Health. Under the existing conditions I believe this could best be accomplished by making the director of the laboratory *ex-officio* a member of the State Board of Health. This would in no way handicap the latter, nor would it detract in any way from the credit due the board for work performed, or directed to be performed by them. It would, however, tend to bring the two bodies closer together, and thus unify the work. At present there is danger that the two bodies will pull in opposite directions, a contingency which would greatly hamper the work of both the State Board of Health and the public health laboratory. It is not necessary that the director of the laboratory should have any executive authority, but if he were given a voice on the

board of health, his suggestions, based upon his laboratory experience, would be certain to have great value.

Although the director of the laboratory need not be given any executive authority, he should not be made an underling who can act only as he is directed by the executive officers of the board. In other words, the laboratory men should have perfect freedom to make independent investigations, and to issue bulletins from time to time based upon their independent investigations. This work need not be a duplication of the work performed by the State Board of Health, and would in no way detract from their glory.

I am in favor, therefore, of placing the State Public Health Laboratory under the control and regulation of the State University, under the direction of the professor of bacteriology or pathology. I believe that the laboratory should perform the work it is directed to do by the State Board of Health, sending the reports of such work to said board. I would have the laboratory, however, given due credit for this work in all reports by the board of health, and to this end it should have an annual or bi-annual report of the laboratory to the Governor of the State, in which all these reports could be incorporated. Furthermore, the laboratory should be free to carry on independent investigations, and should be privileged to publish the results of these investigations in the form of bulletins from the laboratory. It seems to me that a closer affiliation between the public health laboratory at the university and the State Board of Health can be secured if the director of the laboratory were made *ex-officio* a member of the State Board of Health.

The director of the laboratory should have the right in all instances to specify how specimens shall be collected and transmitted, and when specimens are not properly submitted he must be privileged to refuse the examination.

Our present law is defective in several particulars: We are directed to "make bacteriological examinations of body secretions and excretions, waters and foods." With this wording it is difficult to say just how much work we are expected to do, because it includes practically everything of which anyone might wish to have a bacteriological examination made. The result is that we are getting an endless variety of material for examination, and the appropriation is entirely inadequate for the work that we are expected to do. We are at present preparing a bulletin emphasizing the necessity of stopping most of the work that has no direct bearing on the health of the community, such as, for example, the examinations of pathological tissues—work which is in no way connected with the subject of community hygiene. I do not believe that we are quite ready to have the state undertake to pay for every conceivable kind of laboratory examination and analysis.

THE RELATION OF STATE UNIVERSITIES TO PUBLIC HEALTH WORK.*

EDWARD BARTOW,
University of Illinois, Urbana, Ill.

It is my opinion that a very close relation between the State Board of Health and the State University is the ideal relation. In this there are advantages for both parties that neither can afford to miss. The Illinois State Board of Health and the University of Illinois coöperate in tests of water supplies and in the diagnosis of diphtheria; my own experience has been with the former. Under our present arrangement the State Board of Health has the privilege of sending samples of water for analysis. It would be of advantage to both parties if the arrangement could be changed so that the State Board of Health would be more in touch with the analytical work of the university, and if the analytical data obtained could be followed by an investigation conducted by a competent inspector having authority under the State Board of Health.

As has been stated, the State Boards of Health might well make use of the universities, and the universities need the State Boards of Health in order to obtain material for the study of pure food, pure water, social conditions, epidemics, and kindred problems; but they especially need the authority and help of the State Boards of Health to follow up, in a practical way, the results of their experimental work.

The dissatisfaction which sometimes occurs is undoubtedly due to misunderstandings. Too much is expected on both sides. In coöperative relations there should be true coöperation. The officials of the boards and the professors should work as COLLEAGUES, and any other arrangement should be avoided. I have seen, for example, a situation where a professor was treated as a mere analyst. He was supposed to make analyses of material for the inspector of the board and was given no idea of the reason of the work and no knowledge of the use made of the results obtained. A professor cannot afford to spend his time doing such hack work. In fact, if such work were given to a man in private practice, he would undoubtedly turn it over to a paid assistant.

The professor is sometimes expected to do the work without additional cost to the board. It is supposed that because he is already receiving a

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

salary from the state for doing one thing, that he can do anything else anyone connected with the state desires, without additional compensation. This is not fair, as the average university professor already has as much educational work as he can carry. To advance in his profession, he must use any additional time he may have in studying or making experiments along lines connected with the subject in which he has become interested, which will help him financially or add to his reputation. Sometimes the professor is not expected to do the hack work, but money is furnished to pay the salary of a man to work under his direction. This is a better situation, yet if the work is something that is not of special interest to the professor he must use a great deal of time in making himself familiar with the subject at hand, and in giving directions to the helper. With such an arrangement, allowance must also be made to relieve the professor of an equivalent amount of university work.

To summarize, the points I wish to make are that the board's officials and the professors should be colleagues, and that the professors should be relieved from part of their university work by employment of helpers who will not only do the board work but the university work relinquished by the professor.

DISCUSSION.

DR. WILLIAM F. SNOW. I do not believe that the university can do the whole work of the State Board of Health, even if it were desirable to have it do so, and I do not believe the university can ever assume the entire responsibility for an administrative office like that concerned with public health. Consequently I think that the State Board of Health should remain paramount, and so I hold that no legislature should, by legislative action, give any part of the State Board of Health work to the university. In my own state, very fortunately, there is the friendliest coöperation and good feeling between the State University and the State Board of Health. Our hygienic laboratory and our pure food and drug laboratory are located in buildings on the university campus, and manned by university men who are members of the university faculty. The work is going on very well under this regime. The State Board of Health controls the appropriations and is responsible for the work done; the president of the university appoints the directors and assistants. This works well when harmony of purpose exists, but it does not provide against disastrous division of power at any time. I believe, too, that all matters concerning public health should be put in the hands of the State Board of Health, and that the State Board of Health should be held strictly responsible to the people. Then if this board finds it advantageous to arrange with the university for mutually helpful coöperation in any part of its work, such arrangement may be made.

DR. HENRY ALBERT. A law was passed in Iowa, some six years ago, creating a laboratory which has since worked without friction, as far as the two governing bodies are concerned. The bacteriological laboratory of the State Board of Health is located in the university building, although the university authorities have nothing to do with the funds appropriated for the maintenance of this laboratory, as they are administered by the State Board of Health; nor do the university authorities have anything to say with reference to the scope of the work. This latter question rests with the State Board of Health and is determined by conference between the director of the laboratory and the members of that board. There ought to be certain limitations to the scope of work done in a board of health laboratory. Unless pathological examinations have to do with infectious diseases, I do not believe such examinations come within the scope of board of health laboratory work. This is particularly true,

because there are numerous private laboratories which may properly object to the state board of health laboratories interfering with work of a private nature.

DR. H. W. HILL. This discussion has brought out the point that absolute incoördination and lack of uniformity exists almost everywhere in the existing relations of state boards of health to universities, and *vice versa;* and I will ask the President to put the motion which has been moved and seconded to the effect that the Association appoint a committee to deal with this whole matter. (Motion referred to the executive committee.)

THE PURIFICATION OF THE WATER SUPPLY OF RICHMOND, VIRGINIA, BY SEDIMENTATION AND COAGULATION, WITHOUT FILTRATION.*

By EDWIN N. EZEKIEL,
Director Settling Basins and Laboratory, Richmond Water Department.

On December 22, 1909, the new water purification plant at Richmond, Virginia, was put into operation,—a plant which is unusual in its construction, and, I believe, of special interest.

The water supply of Richmond formerly came from a canal, which was filled from the James river six miles above the pumping station. This canal received the drainage of several local creeks before it reached the pumps. After rains, the water in the canal was frequently dangerous, and a small outbreak of typhoid fever was traced to it in 1908. The turbidity of the James River (for the last five years averaged 134 parts per million) has been a serious drawback to the city of Richmond. There are long periods when the turbidity does not go over 30, and turbid periods above 50 seldom last over two weeks.

In 1899, an investigation of James River water, and the best method of clearing it without coagulation, was conducted by Dr. E. C. Levy, bacteriologist, now Chief Health Officer of Richmond, and Professor J. W. Mallet, of the University of Virginia, now retired. The prejudice at that time against the use of a coagulant put mechanical filtration out of the question. Slow sand filtration proved to be impracticable with James River water, on account of matter in suspension so fine that it could not be removed without coagulation.

In 1905, Dr. E. C. Levy made experiments on the relative value of iron and lime, and aluminum sulphate in coagulating James River water. He was at no time able to obtain a satisfactory water with iron and lime as the coagulant. The objectionable color of iron was always left in the treated water, unless enough lime were added, not only to convert all the bicarbonates of calcium and magnesium into normal carbonates, but also to leave an actual caustic alkalinity. This statement applies to water treated only by coagulation and sedimentation. In bottle experiments, where coagulation was followed by filtration, Dr. Levy obtained satisfactory results in respect to the absence of the iron color and lack of caustic alka-

* Read at 38th Annual Meeting of American Public Health Asosciation, Milwaukee, September, 1910.

linity, but as Richmond did not wish to install filters, the latter experiment was of no practical use. The average alkalinity for five years has been 40. During periods of turbid water the alkalinity always decreases, the lowest alkalinity ever recorded in the water of the James River at Richmond being 12. It was in consideration of the above mentioned points that Dr. Levy advised the use of aluminum sulphate for the settling basins.

Settling and coagulating basins were recommended; the advantage of the basins lay in the fact that they had an intake directly from the river with local drainage eliminated. Storage basins, sufficiently large to enable closing the intake gates during turbid periods of the river, were also recommended. Improvement in turbidity and bacteria could be expected by plain sedimentation, and when the water was not sufficiently clear, coagulation followed by sedimentation.

Following these recommendations, a purification plant 6100 feet long and of a width varying with the topography of the location was constructed, containing storage and coagulating basins. A dam in the river, at the head of the plant, insured sufficient water to fill the basins. The two storage basins are each one mile in length, and vary in breadth from 30 feet at the head to 400 feet at the lower end, with an average depth of 8½ feet. The capacity of each storage basin is 85,000,000 gallons. The sides of the storage basins are rip-rapped with granite blocks, and have bottoms of impervious clay. The coagulating basins, which have a capacity of about 15,000,000 gallons, or some 2,000,000 gallons more than the average daily water consumption of Richmond, are about 1000 feet long and vary in width from 400 at the broadest point to 50 feet at the outlet gates, with an average depth of 11¼ feet. The coagulating basin's walls and floors are concrete. At the middle wall, between the storage and coagulating basins, is the coagulating plant and laboratory. A reinforced concrete conduit 5,000 feet long and 5 feet inside diameter conducts the water to the pumping station.

The total cost of the settling basins and conduit was about $553,000.00. The plant was designed by and constructed under the supervision of Mr. Charles E. Bolling, formerly Superintendent of Water Works, and now City Engineer of Richmond.

Experiments on sedimentation, previous to the time the basins were put into operation, showed that when water of a turbidity over 300 was stored for a week, it was reduced in bacteria 71 per cent. and in turbidity 90 per cent. James River water of a turbidity below 35 does not give the high percentage reduction in turbidity that will be obtained from a more turbid water. Theoretically, each storage basin holds one week's supply of water. Such experiments as have been made indicate that

water entering the storage basins pushes ahead of it the water in the basins, hence a full week storage is given all water before it is coagulated.

No way of cleaning the storage basins has been provided. In the city reservoirs, which have a capacity of 23,000,000 gallons each, a mud deposit of 440 cubic yards a year occurred until the settling basins were put into operation. Formerly the reservoirs received all river water, however turbid it was. In the storage basins where only the clearer water of the river is admitted, the deposit should be very slight.

The prejudice against coagulating the water had about died out before the settling basins were put into operation. No water has been sent to the pumping station since the first part of 1910 without being first coagulated by aluminum sulphate.

In the coagulating basins, which are operated on the fill and draw plan, seven hours' time is consumed in coagulating and in filling the basin with water; 14 hours is the average time a basin stands and clears, and 21 hours is the average length of time a basin of clear water supplies the pumps.

The water flows into the conduit from the surface of the coagulating basin, leaving the sludge undisturbed on the floor, as the water is not drawn off low enough to disturb it.

The reservoirs into which the water is pumped have a storage capacity of three days, so any matter left in suspension settles in the reservoirs.

The following example illustrates the benefits derived from the settling basins. On July 5th, the river water had a turbidity of 12. The river rose, and five days later the records showed a turbidity of 100 in the river water, and high turbidities in the river were recorded for the remainder of the month. The gates to the storage basins were closed before the turbid water reached Richmond, and a turbidity of 8 was the highest recorded during this period in the storage basins. In the coagulating basins water of a turbidity of 1 was constantly being supplied the pumps. On the day the river had the turbidity of 1000 and a bacterial content of 850 per c. c., the coagulating basins were sending to the pumps water of a turbidity of 1 and an average bacterial count of 1 per c. c.

The various tributaries emptying into the James River above Richmond cause turbidities of the same degree to be entirely different in character, therefore no regular table of grains aluminum sulphate per gallon of water can be used.

Appended to this paper is a table which gives averages for the operation of the basins from January through July of 1910. The average amount of aluminum sulphate for the first seven months of the year has been 1.61 grains per gallon, 2.8 grains per gallon has been the maximum amount any month, and .87 the minimum amount. The average cost,

which includes labor, coagulant, and other operating expenses per million gallons of water for the seven months, has been $4.37. The average turbidity of James River water for the seven months has been 138, for the storage basins 21, and for the coagulating basins 4 parts per million. The per cent. reduction between the raw and stored water was 82—this is obtained by selection as well as sedimentation. A reduction of 79 per cent. was obtained on coagulating storage basin water, and a total reduction for the seven months of 96 per cent. between the raw river water and the effluent from the coagulating basins. The total average bacteria per c. c. in James River water for the first seven months of 1910 was 5170, in the storage basins 1500, and in the coagulating basins 266. Between the raw and stored water there has been an average reduction of 76 per cent., between stored and coagulated water 81 per cent. reduction, and 96 per cent. total reduction in bacteria between the raw water and effluent from the basins. *Bacillus coli* is frequently found in river water in 10 c. c. tests, but seldom occurs in the coagulating basin water in 10 c. c. tests, and practically does not appear at all in 1 c. c. tests.

The sludge that accumulates in the coagulating basins contains aluminum hydroxide which assists in clearing the water. This sludge is not removed until it banks so high as to interfere with the successful operation of the basins. While one coagulating basin is being washed, which process occurs at intervals of about two months, clear water is supplied by continuous coagulation in the other basin. Wash water is pumped from the full coagulating basin then supplying the pumps into the one being washed. Some 2,565,000 gallons remain with the sludge in the coagulating basin after the water to go to the pumping station has been drawn off, and this water is wasted into the river when the basin is to be cleaned. For the washing process 343,000 gallons of water are pumped from the full coagulating basin, so that a total of 2,908,000 gallons are consumed in cleansing a basin. Between washings 445,000,000 gallons are coagulated. The itemized cost of washing a basin in August was as follows:

Labor	$ 62.00
Gasoline for engine	36.25
Machine oil	4.75
Wash water	5.00
Total	$108.00

A calculation on the basis of 445,000,000 gallons of water cleared between washings, and a cost of $108,00 for washing, gives an average cost of 24 cents per million gallons.

Mechanical filtration requires that an average of from 2 to 5 per cent of the total quantity of purified water be used for washing filters. At the settling basins .65 is the total quantity of purified water used for washing a basin.

The data given in this paper apparently indicate that the city of Richmond is now being supplied with clear pure water at a cost for operation, that compares favorably with filtration, and at a much lower cost for washing.

TABLE I.

OPERATING RESULTS OF JAMES RIVER, STORAGE BASIN AND COAGULATING BASINS, WATER PURIFICATION PLANT, RICHMOND, VIRGINIA.

Month 1910	Average Turbidity			Perc't'ge Reduction Between			Average Bacteria per Cubic Centimeter			Perc't'ge Reduction Between			Aluminum Sulphate Average Grs. per Gal.	Cost per Million Gallons for Water
	River	Storage Basins	Coag. Basins	River and Storage B.	Storage and Coag. Basins	River and Coag. Basins	River	Storage Basins	Coag. Basins	River and Storage B.	Storage B. and Coag. B.	River and Coag. B.		
January...	185	29	8	84	72	95	19276	4765	1291	75	73	93	2.8	$5.49
February.	105	24	3	77	87	97	6825	4616	361	32	92	95	1.7	4.58
March....	74	14	3	81	78	96	3652	554	117	84	78	96	.87	3.05
April.....	102	9	3	91	66	97	2477	136	35	95	74	98	1.12	3.37
May.....	41	13	3	68	77	93	366	97	13	73	86	96	1.37	4.19
June.....	194	29	4	85	86	98	2681	211	27	92	87	99	1.44	4.89
July.....	267	28	3	89	89	98	927	120	21	87	82	97	1.97	5.15
Averages.	138	21	4	82	79	96	5170	1500	266	76	81	96	1.61	4.39

HYPOCHLORITE TREATMENT OF PUBLIC WATER SUPPLIES: ITS ADAPTIBILITY AND LIMITATIONS.*

By GEORGE A. JOHNSON,
New York City.

The use of hypochlorites for sterilization purposes has now reached a stage where its field of usefulness in the destruction of objectionable bacterial life in public water supplies, filtered or unfiltered, is well understood. Until the fall of 1908 the data were scarce and more or less indefinite as regards practical application, but since that time enough history has been made to allow of the statement that a new epoch in the art of water purification has been ushered in—an epoch which is revolutionary in character and which will always remain one of the most striking developments in the art of water purification.

The practical merits of filtration in minimizing water-borne diseases have been widely recognized and accepted for less than twenty years. The writings of antiquity disclose strikingly few references to the filtration of water for the purpose of purifying it and making it safe for human consumption, probably the earliest reference being that which appeared in the "*Ousruta Sanghita*," a collection of medical lore written in Sanskrit probably some 4,000 years ago. In a letter to the British Journal of Preventive Medicine, Mr. Francis E. Place, B. Sc., of Jaipur, Rajputana, India, calls attention to this reference, in which the following appears: "It is good to keep water in copper vessels, to expose it to sunlight and filter through charcoal."

As late as 1892 the efficiency of slow-sand filters was seriously questioned by a large number of medical authorities and engineers. Their arguments against filtration were very largely based upon such occurrences as the outbreak of typhoid fever in that portion of Berlin, Germany, which was supplied with filtered water from the old Stralau works. Many prominent sanitarians did not hesitate to express the conviction that filtration of impure water for municipal use was an ineffective safeguard against water-borne diseases, and altogether improper, and that public water supplies should be drawn only from pure mountain streams and ground waters. The abandonment of filtered Thames River water in favor of water from mountain streams was strongly advocated for London, and the current literature of that day on the subject showed a clear over-balancing tendency against filtration in general.

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

In marked contrast to the slow development of the science of water purification up to 1890, or thereabouts, is the remarkable progress in this field of municipal sanitation during the past twenty years. In 1890 less than 200,000 people in this country were being supplied with filtered water, and ninety per cent. of this water came from rapid sand filters which bore little resemblance to filters of this type which have been built during the last ten years. In 1900 the number of people supplied with filtered water had increased to 1,860,000, and in 1904, to 3,160,000. At the present time nearly 8,000,000 people, or over 22 per cent of the urban population of continental United States, are being supplied with filtered water.

LIMITATIONS OF FILTRATION PROCESSES.

When the first municipal filter was built at London, England, in 1829, the only office it was expected to perform was that of a mechanical strainer in removing turbidity from the water—the germ theory of disease had not then been advanced. It was not until 1849, during the severe cholera epidemic of that year, that this theory assumed definite proportions. With the recognition of the germ theory of disease came the realization that polluted water, when passed through beds of sand, was made safer for human consumption. This, however, as before stated, was not widely recognized, and in the late eighties the art of water filtration for municipalities was on a very insecure basis. The striking results obtained at Altona, Germany, during the cholera epidemic at Hamburg in 1892, did more than anything else to convince the sanitary world, and the general public, that filtration of polluted waters was deserving of the most serious consideration in connection with efforts to minimize the death rate from water-borne diseases. The splendid work of the Altona filters during the Hamburg cholera epidemic is too well known to require repetition here.

About the time of this epidemic, the Massachusetts State Board of Health, as a result of the information accumulated during the early years of the work at Lawrence, arrived at the conclusion that the purification of waters as highly polluted with sewage as those of the Merrimack River could be successfully accomplished at a reasonable cost. Cholera, probably emanating from Hamburg, appeared in New York harbor in the same year, and its appearance caused the city officials of Lawrence to decide upon the construction of a slow sand filtration plant, thereby taking a step which was to prove to be the opening of an era of practical accomplishments in America in the field of water filtration. It must also be pointed out that sand filter plants were built as early as 1874, at Poughkeepsie and at Hudson, New York.

It is probable that the most sanguine advocates of water filtration have never firmly believed that filtration of polluted water, even when carried cut with the greatest care, would at all times render it entirely free of bacteria, or would do more than greatly minimize the danger from drinking it.

The hygienic efficiency of filter plants is usually stated on a basis of the percentage removal of bacterial life from the unfiltered water. Ordinarily such removal amounts to 90 per cent and over, and it is clear that the danger in drinking polluted water is minimized in proportion to the removal of bacterial life. Filters will not remove all bacteria, and probably a fair statement of the safety of a filtered water for drinking purposes would be to say that, other things being equal, it will to a considerable extent vary with the quality of the unfiltered water. In other words, a water which is primarily but slightly polluted will be potentially less dangerous to the public health after filtration than one which is initially foully impure.

Regardless of the initial impurity of a water, efforts have always been directed toward keeping as low as possible at all times the number of bacteria in the filtered water. In Germany the effort has been made to set and maintain a standard of purity for filtered waters of 100 bacteria per cubic centimeter, and when the filtered water contained a higher number than this the filter was to be judged inefficient and was to be shut down and cleaned. The results of the practical operation of large filtration works in this country and abroad show clearly that it is not possible at all times to live up to such a standard as this, and that there will be times in the use of practically all filters when the number of bacteria in the filtered water will amount to several hundred per cubic centimeter.

Filtration of impure waters has undoubtedly been instrumental in reducing by about 75 per cent, on the average, the typhoid death rate in cities in this country using filtered water. It is reasonably certain that there is also brought about by filtration a very material reduction in the death rate due to other diseases than typhoid fever, substantiating the theorem of Hazen.

By filtration, water may be at all times made clear and free from turbidity and color and substantially free from bacterial life. In the last two years the practical adaptability of hypochlorites in rendering practically sterile filtered waters—and unfiltered waters as well—has been clearly demonstrated. The hypochlorite treatment would therefore appear to be a finishing touch in the art of water purification, and would make available an exceedingly economical and harmless means of remov-

ing virtually the last fraction of potential danger from drinking water, whether initially impure or merely under suspicion at times.

HISTORICAL RESUME OF HYPOCHLORITE TREATMENT.

The use of hypochlorites for the destruction of objectionable bacteria in water and in sewage has been a matter of considerable active investigation on a small scale for some twenty years, although it was studied in connection with the deodorization of the London sewage, as reported upon in 1861 by the Royal Commission on Sewage Disposal. The investigators who have studied the action of hypochlorites on bacteria are numerous, and include such well-known workers as Ballner, Barsenge, Clark, Deiter, Dibden, Digby, Dunbar, Elsner, Fermi, Fowler, Gage, Houston, Hunerman, Kaufmann, Kellerman, Kimberly, Konig, Korn, Kranepuhl, Kurpjuweit, Lodi, McGowan, McLintock, Nissen, Phelps, Pratt, Proskauer, Remele, Rideal, Schumacher, Schwartz, Shenton, Sickenberger, Traube, Webster, Woolf, Zirn, and others.

The late Thomas M. Drown observed that the American Public Health Association recognized the value of hypochlorites as early as 1888; and the experience and results obtained at Maidstone, England, in 1897, and at Lincoln, England, in 1904, are too well known to require repetition. The use of hypochlorites at Worthing, England; Middlekerke, Belgium; Nice, France; Poplar, England; Havana, Cuba; Vera Cruz, Mexico; Brewsters, New York; Red Bank and Boonton, New Jersey; Baltimore, Maryland; Union Stock Yards, Chicago, and numerous other places, has supplied valuable information which has in all ways confirmed the earlier favorable ideas of the applicability of these compounds for general sterilizing and deodorizing purposes.

Up to 1908 the use of hypochlorites in the purification of public water supplies had not received serious consideration. Most of the information then available was fragmentary and more or less indefinite in character, and the process had not gained general credence. The first demonstration in this country in a practical way of the usefulness of hypochlorites in connection with water purification was made in the fall of 1908 at the filter plant of the Chicago Stock Yards, on the recommendation and under the direction of the writer. Following directly on the heels of the spectacular results obtained at Chicago, came the adoption of this process for the sterilization at Boonton, New Jersey, of the impounded and unfiltered water supply of Jersey City, with which work the writer was also connected. The results obtained at these two places were given wide publicity, and almost immediately the use of hypochlorites, either intermittently or continuously, spread throughout the United States. Among its users at this

time are many of the largest cities of North America, including Brooklyn and New York; Cincinnati and Columbus, Ohio; Harrisburg, Philadelphia, and Pittsburgh, Pennsylvania; Hartford, Connecticut; Montreal, Quebec; Nashville, Tennessee; and St. Louis, Missouri

THE JERSEY CITY CASE.

Probably the most complete line of information regarding the chemistry of this process was secured during the litigation between Jersey City, New Jersey, and the Jersey City Water Supply Company, which water company, as has been said, was one of the first to make continuous use of hypochlorites as a germicide. After the sterilization plant of the Jersey City Water Supply Company had been in practical operation for several months, during which the quantity of water treated amounted to over 40,000,000 gallons daily, extended testimony was taken in the Court of Chancery before Special Master ex-Chancellor Magie, the testimony being given by Professor H. B. Cornwall of Princeton University; J. A. DeGhuee, New York City; J. W. Ellms, Cincinnati Filtration Works; George W. Fuller, Rudolph Hering and Geo. A. Johnson of New York City; C. E. Garside, New York City; X. H. Goodnough, Boston, Mass.; Professor G. A. Heulett, of Princeton University; N. S. Hill, New York City; Daniel D. Jackson, Brooklyn, N.Y.; Professor Leonard P. Kinnicutt, Worcester Polytechnic Institute; Dr. John L. Leal, Paterson, N. J.; Dr. Ernst J. Lederle, New York City; Dr. George E. McLaughlin, of Christ Hospital, Jersey City, N. J.; Professor William P. Mason, of the Rensselaer Polytechnic Institute; Dr. Charles E. North, of New York City; Professor William H. Park of Bellevue Hospital and New York Research Laboratory; Professor E. B. Phelps, New York City; the late Professor Franklin C. Robinson, of Bowdoin College; Professor Wm. T. Sedgwick, of the Massachusetts Institute of Technology; Professor F. F. Wesbrook of the University of Minnesota; George C. Whipple of New York City; Professor C.-E. A. Winslow of the Massachusetts Institute of Technology; and others.

In his opinion rendered in May, 1910, and based upon the testimony given by the foregoing witnesses, ex-Chancellor Magie made the following statements:

> "From the proofs taken before me, of the constant observations of the effect of this device, I am of the opinion and find that it is an effective process which destroys in the water the germs, the presence of which is deemed to indicate danger, including the pathogenic germs, so that the water after this treatment attains a purity much beyond that attained in water supplies of other municipalities. The reduction and practical elimination of such germs from the water was shown to be substantially continuous."

"Upon the proofs before me, I also find that the solution described leaves no deleterious substances in the water. It does produce a slight increase of hardness, but the increase is so slight as in my judgment to be negligible."

"I do therefore find and report that this device is capable of rendering the water delivered to Jersey City pure and wholesome, for the purposes for which it is intended and is effective in removing from the water those dangerous germs which were deemed by the decree to possibly exist therein at certain times."

DESCRIPTION OF THE CHEMICAL, AND NATURE OF THE PROCESS.

Much has already been written about the chemistry of the process of hypochlorite treatment in the sterilization of water, but it may be that a condensed statement in this connection may not now be out of place.

Hypochlorite of lime, commercially known as "chloride of lime" or "bleaching powder," has been, and is, extensively used for bleaching purposes in paper mills and in many textile industries. It is sold in the form of a dry white powder and is usually shipped in wooden or sheet-iron containers of a capacity ranging from 100 to 750 pounds each. It is manufactured at numerous places in this country, as well as abroad, and its cost in large quantities is about one and one-third cents per pound at the works. When exposed to air the powder deteriorates in strength rather rapidly, because of the absorption of moisture and carbonic acid. It is usually bought on the basis of its strength in so-called "available chlorine." The product in this country usually runs about 35 per cent pure, according to this standard.

When the hypochlorite in the powder form is dissolved in water containing carbonic acid, hypochlorous acid is liberated. This acid is a powerful oxidizing agent, and in the presence of organic matter gives up oxygen in an atomic state with an amount of energy which makes this chemical approach ozone in intensity of action as an oxidizing and sterilizing agent. It is generally considered to be superior to ozone for practical purposes, for the reason that it is more easily applied and brought into speedy and thorough contact with all parts of the water to be treated, which appears not now possible in the case of ozone. There seems to be no doubt, also, that it always is materially cheaper than ozone.

The chemical itself, as bought, is a mixed salt which consists of approximately equal amounts of calcium chloride and calcium hypochlorite. When the powder is added to water the calcium chloride remains inert, but the calcium hypochlorite, being acted upon by the free and half-bound carbonic acid in the water, splits up into calcium carbonate and hypochlorous acid. The decomposition of the exceedingly unstable hypochlorous acid liberates oxygen in a very active state and leaves hydrochloric acid. The latter then drives off the weaker carbonic acid and

unites with the calcium, forming calcium chloride. It is the liberation of oxygen in this manner that effects by oxidation the destruction of bacterial life.

The general result following the application of hypochlorite of lime to water is the destruction of the majority of the non-spore-bearing forms of bacterial life which the water may contain, a reduction in the organic color of the water, an oxidation of the organic matter proportional to the amount of the chemical applied, and a slight increase in the total hardness and total solid matter of the water. Where quantities no greater than from five to fifteen pounds of the powder are applied to each million gallons of water, as is the common practice, the changes in the physical and chemical characteristics of the water before and after treatment are so slight as to be barely noticeable and are well within the limits of accuracy of the prevailing methods of analysis. The important result and greatest change is the virtual destruction of the bacterial life in the water, more particularly the disease-producing germs. Included in this group are the germs of Asiatic cholera and typhoid fever.

HYPOCHLORITE OF SODA.

There is another method of obtaining hypochlorites, and that is through the electrolysis of solutions of common table salt, whereby hypochlorite of soda is produced. Careful study of the relative efficiency of hypochlorite of lime obtained from bleaching powder, and hypochlorite of soda electrolytically produced from common table salt, shows that, unit for unit, hypochlorite of soda is slightly more efficient in the destruction of bacterial life than hypochlorite of lime. The process of manufacture of hypochlorite of soda is not so well understood from a chemical standpoint, however, but it appears certain that where electric current can be obtained for one and one-half cents or less per kilowatt hour, and salt for one-third of a cent per pound, or less, hypochlorite of soda will prove to be a cheaper germicidal agent than hypochlorite of lime. Furthermore, in some cases its use may be preferable to that of hypochlorite of lime, because of the aesthetic objections sometimes raised against the use of bleaching powder, which, in the case of the electrolytic solution, should be entirely overcome. It is understood that at the water purification works of the city of Cincinnnti, preparations are now being made for the installation of electrolytic cells in which hypochlorite of soda will be manufactured and substituted for the hypochlorite of lime used in the past.

It has been asserted by some that free chlorine is liberated from the bleaching powder as applied to water and that it may persist for some time in water so treated. In this connection it may be said that the term

"available chlorine" is a convenient term used by the analyst to express the strength of the bleaching powder or the electrolytically prepared solution of hypochlorite of soda. This term was adopted by industrial chemists for the reason that in bleaching operations at some places the commercial product is treated with strong acids which can break up the chemical and release free chlorine. It is perfectly clear that if free chlorine could be released from bleaching powder when applied to water, such free chlorine would immediately combine with the hydrogen of the water and form hydrochloric acid, and at the same time liberate free oxygen in an atomic state. The final result, therefore, would be the same.

ABSENCE OF POISONOUS FEATURES.

There is plenty of evidence of a conclusive character to show that the weak carbonic acid, as found in natural waters, is incapable of releasing appreciable or even measureable quantities of free chlorine from bleachimg powder. Instead of this, hypochlorous acid is produced—and hypochlorous acid is not a poison. Upon its decomposition with organic matter, the chlorine which the hypochlorous acid contains combines with the alkalinity of the water and forms calcium chloride. By present laboratory methods no free chlorine is found in the application of this chemical to an ordinary water supply. In the past, efforts have been made by those who did not favor the process to locate a toxicologist who would classify this treatment as a poisonous one, but such efforts have been unavailing.

In the Jersey City case, Professor G. A. Heulett testified that in his examination of the Jersey City water to which had been added ten pounds per million gallons of bleaching powder, he was unable to determine the presence of free chlorine. It is a fact that there has been no chemical test yet devised which is capable of identifying the presence of free chlorine in an alkaline solution such as normal surface water. Professor Heulett stated, however, basing his assumption upon the theory of electrolytic dissociation and giving all possible benefit of the doubt to the plaintiff in the case, that if ten pounds of bleaching powder per million gallons were added to the Jersey water, it was theoretically possible for free chlorine to the extent of 6.4 parts in a trillion parts of water to be present in the water after treatment. He admitted that he was unable to prove this assumption. It was furthermore pointed out in this case that if Professor Heulett's theory was correct, in order for an adult to obtain a medicinal dose of free chlorine, such as has been administered in cases of typhoid fever as an anti-ferment and germicide, it would be necessary for such a person to drink a gallon of water so treated each day for 7,180 years.

PREPARATIONS OF HYPOCHLORITE SOLUTIONS.

It is the more common practice to make up hypochlorite solutions of one-half per cent strength, that is, one pound of the bleaching powder to 200 pounds of water. It is probable that solutions as strong as four or five per cent may be made without material loss of oxidizing power, but the more dilute the solutions are, the more easy they are to work with, because of the deposits of quicklime formed in orifices and in pipes. It is well to point out that where electrolytically-produced solutions of hypochlorite of soda are used, no trouble is had on account of deposits of sludge, as is the case with hypochlorite of lime. This is another feature of no little importance in favor of the use of hypochlorite of soda.

Concrete appears to be the most suitable material for solution tanks. Iron tanks may be used, but they are attacked by the chemical and eventually eaten through, although they last a long time owing to the protection afforded by deposits of lime upon the exposed surfaces. Black iron pipes have lasted for over two years at the Boonton plant and at a number of places special bronze pumps have worn well. Wooden tanks are the least suitable of all, but if wood is used cypress seems to be the best material. White pine is reduced to pulp in a comparatively short space of time.

When solutions of bleaching powder are used, it is essential that the contents of the tank be thoroughly stirred at the outset, in order to get into solution all of the soluble portion of the powder. Later on, stirring is convenient to keep the sludge well distributed; for if not stirred, it becomes troublesome as the last portion of the solution is removed from the tank. Tanks ten or twelve feet deep, containing a one-half per cent solution of bleaching powder, or hypochlorite of lime, will ordinarily show a deposit of lime sludge about one inch thick, which contains about as much of the active agent as the one-half per cent solution does. Care should therefore be taken in its disposal, otherwise it will cause trouble to fish in water into which it is emptied.

Solutions deteriorate but little when standing in covered tanks that are constantly stirred—perhaps some two per cent in a day or two.

Considerable attention has very recently been given to the feasibility of applying the bleaching powder in dry form. If appliances can be devised that will allow of the addition to water of a suitable quantity uniformly at all times, more or less automatically, there is no reason to suppose that hypochlorite applied in the form of powder will not act as satisfactorily as in the form of a solution, provided there are afforded adequate facilities for complete mixing of the dry powder with the water to which it is applied. Hypochlorite of lime absorbs moisture rapidly, and

this is probably a difficulty which will be hardest to overcome where the application is in the dry form, as with time the powder will tend to lump and grow pasty.

PERIOD OF CONTACT.

All available data indicate clearly that the germicidal action of hypochlorites is exceedingly rapid. This is due, of course, to the fact that atomic oxygen is released promptly when the chemical is applied to the water.

As a general proposition it is thought advisable to provide for a contact period of at least one hour before the treated water is delivered to the consumer. In some cases even shorter periods have given satisfactory results. Such periods of contact in some cases are provided by long pipe lines or distributing reservoirs between the point of application of the hypcchlorites and the nearest consumer. It is also highly important that the chemical be quickly and thoroughly mixed with the water, a process which is usually effected by mechanical stirrers or baffling arrangements.

AMOUNT OF CHEMICAL TO BE USED, AND BEST POINT OF APPPLICATION.

The best point of application of hypochlorite to a water depends largely upon the conditions surrounding each individual problem. As a general proposition, as before stated, from five to fifteen pounds of the powder per million gallons of water are required to effect practical sterilization of filtered or unfiltered waters which contain normal amounts of organic matter. If the water contains abnormal amounts of organic matter, or iron in an incompletely oxidized state, considerably larger quantities of the germicide are required to obtain the best results. Each individual problem must be studied by itself and the correct dose of the germicide ascertained in the beginning.

The earliest studies with hypochlorites were directed at the total elimination of bacterial life, but this is not now considered necessary in the sterilization of water. The principal object is to destroy all disease-producing germs, such as those of typhoid fever, if such germs are present. This can be done without effecting the complete destruction of all bacterial life in the water, for the reason that the typhoid bacillus, as well as the colon bacillus, is less hardy than most forms of bacterial life which naturally predominate in water and which are known to be non-pathogenic. Their removal, therefore, is not a matter of consequence as regards the sanitary quality of the water. It is known that hypochlorite has a selective action upon such germs as the bacillus of typhoid fever and *B. coli*,

and owing to their less resistant state in water it destroys them more quickly and completely than it does some of the harmless forms of bacteria common to water. It is not unusual to find that such bacteria as resist the hypochlorite treatment are spore formers and other hardy forms of non-pathogenic water bacteria.

To determine the amount of hypochlorite to be added to a given water, the latter must first be carefully studied in connection with the germicidal treatment, and the quantity of the chemical which gives satisfactory results under normal conditions ascertained as nearly as possible. When this amount is found, it is the common practice to increase this quantity some 25 per cent. in order to guard against sudden fluctuations in the quality of the untreated water which may increase its power of absorption of the hypochlorite. Where the germicide is added to a filtered water, such fluctuations are much less marked.

PRECAUTIONS AGAINST UNDER-DOSING AND OVER-DOSING.

It is obvious that if too little of the germicide is used there may be an unwarranted feeling of security, for the reason that for months the results may be thoroughly satisfactory with the application of a given quantity of chemical, and then, owing to a sudden change in the character of the water, unsatisfactory results may be obtained. For this reason it is always better constantly to use more of the chemical than is actually required under normal conditions.

On the other hand, over-dosing is quite as undesirable. If the attempt is made to effect complete sterilization of the water rather than to secure the destruction of the pathogenic bacteria, there is a strong probability that at times there will be imparted to the water an undesirable taste or odor which has been variously considered by laymen to be similar to carbolic acid or iodoform. It is not believed that, within working limits, the presence of an excess of this chemical in water is deleterious to health, but it is objectionable to the senses and is therefore inadmissible. There is no excuse for such over-dosing, for when the quantity of chemical required under normal conditions is once ascertained, by making use of a moderate amount over this quantity a sufficient margin of safety has been provided to meet ordinary conditions.

ADVANTAGES OF THE PROCESS.

Reciting the practical status of the use of hypochlorites in connection with the purification of water, it may be stated that the advantages of the process are the following:

1. Substantially complete destruction of objectionable bacteria, particularly those of intestinal origin.

2. Reliability and ease of application of the chemical, together with small variation in the required dose.

3. Total absence of poisonous features, either in the chemical product, as applied to the water, or in any of its resulting decomposition products.

4. Merely nominal cost of the chemical and its application.

5. Speed of reaction, making unnecessary any substantial arrangements as to basins other than storage facilities.

6. Substantial saving in the cost of coagulation of waters that are of sufficiently unsatisfactory appearance to require clarification or filtration.

7. Rates of filtration materially in excess of those possible where high bacterial efficiency is required of the filtration process in the absence of sterilization.

8. Reduced clogging of the filter beds with a consequent lengthening of the runs between cleanings, due to the destruction of various forms of algae.

LIMITATIONS OF THE PROCESS.

In making a complete analysis of the practicability of this process, it is necessary to recognize the fact that it is not possible by the use of this germicide to overcome certain disadvantages, such as the following, which do not appear in connection with certain styles of water treatment:

1. Inability to remove or destroy all of the spore-forming bacteria not considered to be pathogenic to man, at least not those common to water.

2. Inability to remove bacteria which are embedded in particles of suspended matter.

3. Inability to remove turbidity.

4. Inability to remove appreciable amounts of color or dissolved vegetable stain.

5. Inability appreciably to remove organic matter.

6. Inability to remove swamp tastes or odors.

7. Inability to remove creosote tastes or odors coming from the cleaning of stills used in the destructive distillation of wood.

8. Inability to soften water; as a matter of fact, the addition of hypochlorite of lime usually results in a slight increase in the hardness of the water—although this is not ordinarily measureable—notwithstand-

ing the fact that the commercial product usually contains a little free quick lime which reduces slightly the carbonic acid in the water.

9. Difficulties encountered in applying this process, except with the greatest care, to waters which contain substantial quantities of reducing agents or compounds capable of oxidation, such as nitrites and unoxidized iron.

The foregoing statements set forth the advantages and short-comings of this process which, like other things that are new, is likely to be, and in some cases is, considered a cure-all for all water ills, no doubt with disappointing results in some cases.

The application of hypochlorite to water, while comparatively simple, should always be carried out with much care and fidelity by a competent analyst; otherwise if the dose is not adjusted so as to meet satisfactorily all local conditions, there is liable to be alternately an overdose of the chemical insufficient to sterilize, or an overdose which will result in objectionable tastes and odors readily noticeable to the consumers, and due to the bleach itself.

The use of hypochlorites cannot be considered in the light of a substitute for filtration. Where waters are uniformly satisfactory in appearance, but open to suspicion as regards their content in bacteria, the use of the hypochlorite process alone in many cases may prove sufficient. Where waters are unsatisfactory in physical appearance and are also polluted and require filtration, the combined use of filters and the hypochlorite process is called for. As an adjunct to filtration processes it has a distinct field of applicability, as above stated, for at a moderate cost it is feasible to obtain a water which is practically above suspicion; and, furthermore, there is brought about a substantial economy in the first cost of the filtration plant. This is made possible by the use of higher rates of filtration than are ordinarily used, and the required filter area may therefore be reduced. It also effects a substantial economy in the cost of operation.

Laboratory Section

PRELIMINARY REPORT OF THE COMMITTEE ON STANDARD METHODS OF SHELL-FISH EXAMINATION.*

The committee has held four meetings during the year,† and carried on considerable correspondence, but deems it inadvisable to present a final report at this time. During the coming year a large number of examinations of shell-fish are to be made by members of the committee and by others, and the results ought to be of great value in supplying data concerning some of the important questions that have arisen, particularly those relating to the efficiency of methods of testing for bacteria of the *Bacillus coli* type and the significance of the results obtained by their use.

Pending a final report a year from this time, we suggest the following tentative program to those undertaking sanitary shell-fish examinations, with the further suggestion that they communicate their results to the secretary of the committee.

The following may be considered as the main divisions of laboratory work in connection with sanitary shell-fish examination: The collection, transportation and examination from a chemical and bacteriological standpoint of samples from

A. Shell-fish in the shell (shell stock).
B. Opened shell-fish (shucked stock).

TENTATIVE METHOD OF PROCEDURE FOR SHELL STOCK.

Selection of Sample.

In the case of oysters, it is recommended that twelve (12) oysters of the average size of the lot examined, with deep bowls, short lips, and shells tightly closed, be picked out by hand and prepared for transportation to the laboratory. In the case of other shell-fish, those of average size and in good condition should be selected.

Transportation of Samples.

The oysters (or other shell-fish) should be packed in suitable metal or pasteboard containers of such size and shape that a number of them can be enclosed in a shipping case, capable of satisfactory refrigeration by means of ice. The important points in this connection are:

* Read before the Laboratory Section of the American Public Health Association, Milwaukee, September, 1910.
† 1910.

A. The prevention of the mixing of shell-fish liquor between different samples, and of the mixing of the ice water with the shell-fish.

B. The icing of the samples, if they are not to arrive at the point of laboratory examination inside of thirty-six hours or if the outside temperature is above 50° F.

It is not necessary to enclose the shell-fish in an absolutely tight container, providing the above conditions are maintained.

Condition of Samples.

Note should be taken of the general condition of the shell-fish when received, especially whether the shells are open or closed; of the presence of abnormal odors; and of the temperature of the stock.

Technical Procedure.

The shell-fish should be thoroughly cleaned with a stiff brush and clean running water, and then dried. The edges of the shell should be passed through the flame or burned with alcohol. In the case of oysters, the opening of the shell-fish may be accomplished by either of two methods:

A. By the use of a sterile oyster knife in the usual manner.

B. By drilling through a flamed portion of the shell near the hinge with a sterile drill. It would be well to sterilize both the drill and shell side at least once during the drilling process.

The former method is generally used.

Bacterial Counts.

Bacterial counts should be made, using agar made in accordance with the methods recommended by the Committee on Standard Methods of Water Analysis, and incubating at 37° C. for 24 hours and at 20° C. for three days, using measured quantities (1.0; 0.1; 0.01 cc., etc.) of shell water of each of five shell-fish.

The committee is not as yet prepared to express an opinion as to the value of the results of bacterial counts in the sanitary shell-fish examinations of shell stock, but suggests that reports upon such examinations would be of great value in arriving at a conclusion on this point.

Determination of Bacteria of the *Bacillus Coli* Type.

The committee is not now prepared to make final recommendation concerning special procedures for qualitative and quantitative determination for this group of organisms, and until such a recommendation is made, it advises that the methods used conform as far as possible to the standard methods used for water analysis. The following is suggested as giving satisfactory results.

A. Quantitative determination of the presence of *B. coli* in measured quantities (1.0; 0.1; 0.01 cc., etc.) of the shell water of each of five shell-fish selected from the dozen, by the inoculation of fermentation tubes containing some one of the various liquid media recommended for presumptive tests for *B. coli*, and the incubation of the same for three days at 37° C., with daily observations of the percentage of gas formed.

It is thought that the use of lactose bile in such tubes, either as the primary fermentation test or as secondary to fermentation tests started in liver broth, has given more satisfactory results than any other liquid culture media. The suggestion is also made that when the "liver-broth-lactose-bile-method" is followed, the technique described by D. D. Jackson and his associates be adhered to so far as possible. Attention is called to the fact that if liver broth is used as a preliminary culture medium, its period of incubation must not exceed 18 hours, and preferably should be less than this.

The use of liquid media in fermentation tubes may be supplemented by tests with solid media as outlined below, the special object being to obtain colonies of bacteria of the *B. coli* type, if present, during the first 24 hours, thus allowing a prompt confirmation of their morphological and biological characteristics.

B. Determination of *B. coli* or allied forms through the sowing of measured quantities (1.0; 0.1; 0.01 cc., etc.) of shell water of each of five shell-fish on solid culture media of special composition for the development and differentiation of *B. coli*, such as lactose bile salt, esculin bile salt, Endo's, malic acid, malachite green or MacConkey's agars, etc.

TENTATIVE METHOD OF PROCEDURE FOR SHUCKED STOCK.

Selection of Sample.

After thoroughly mixing the stock in the container from which the sample is to be taken, one or more wide mouthed sterile jars, of the total capacity of approximately two quarts, should be filled by means of a clean ladle, or other instrument, sterilized by flaming alcohol. This jar or jars should be so sealed as to exclude all possibility of contamination from without.

Transportation of Sample.

When the time between the collection of the sample and its examination exceeds three hours, or if the outside temperature is above 50° F., the sample should be thoroughly refrigerated by means of ice.

TECHNICAL PROCEDURES.

The bacteriological examination should not be made until twenty-four hours has elapsed from the taking of the samples. In the meantime the jars should remain unopened and refrigerated.

The methods of chemical analysis will be considered in a subsequent report.

BACTERIAL COUNTS.

Same as for shell stock.

DETERMINATION OF BACTERIA OF THE *Bacillus Coli* TYPE.

Same as for shell stock, with the exception of the use of higher dilutions than 1-100th cc. and the making of triplicate tubes from each dilution.

STATEMENT OF RESULTS.

The committee wishes to state emphatically that the results of bacteriological examinations should not be used as the sole basis for the interpretation of the sanitary quality of shell-fish. The results of the sanitary survey in all cases should be considered of at least equal importance. We are not prepared to give expression of opinion at this time to any definite numerical relation between the various factors involved in the bacteriological results, nor in the sanitary survey, but expect that with the additional information to be available during the coming year, it will be possible to express these relations with some definiteness by means of the score card system. Looking forward to such a system, the committee suggests that in the case of shell stock the results of bacteriological examinations for *B. coli* be expressed by the following arbitrary numerical system, to be known as "The American Public Health Association Method of Scoring Oysters for *B. coli*:—"

The presence of *B. coli* in each oyster of the five examined is to be given the following values, which represent the reciprocals of the greatest dilutions in which the test for *B. coli* is positive:

If present in 1.0 cc. but not in 0.1 cc., the value of 1.
If present in 0.1 cc. but not in 0.01 cc., the value of 10
If present in 0.01 cc. but not in 0.001 cc., the value of 100, etc.

The addition of these values for the five oysters would give the total numerical value for the sample and this figure would be the score for *B. coli*.

The results should be expressed in the following tabular form:

RESULTS OF TESTS FOR *B. COLI* IN DILUTIONS INDICATED.

Oysters	1.0 cc.	0.1 cc.	0.01 cc	Numerical Value
1	+	+	0	10
2	+	+	0	10
3	+	0	0	1
4	+	0	0	1
5	+	0	0	1
	Total, or score for *B. coli*			23

+Presence of *B. coli* group in fermentation tube test with lactose bile where subsequent isolation tests have confirmed the results of the presumptive test or other satisfactory test.
0 Failure to demonstrate presence of *B. coli* group.

It will be seen that if the *B. coli* score is divided by 5, the standard number of oysters tested, the results will approximate the number of *B. coli* per cubic centimeter of shell water. Partly because it does not do this exactly, but also for simplicity and the avoidance of fractions, the method of stating results as an arbitrary "score" is preferred by the committee. Practical experience with the method has also appeared to justify this conclusion. If some other number of oysters than five is tested, the results can be reduced to this score by following the same method and applying the rule of three to the total numerical value.

Sometimes results similar to the following are obtained; that is, one or more oysters may show positive results in small quantities of shell water, while an equal number may show negative results in larger quantities. In this case the next lower numerical value should be given to the positive results in the high dilutions, and such positive results should be considered as being transferred to a lower dilution giving negative results in another oyster. This is done in order to avoid the unnatural result that could follow from what is probably an unequal distribution of the bacteria in the shell water. This recession of numerical values, however, should not be carried beyond the point where the number of such recessions is greater than the number of instances where other oysters in the series failed to give positive *B. coli* results.

As examples of the method of obtaining the score for *B. coli*, the following illustrations are given. They represent results that may be met with in practice.

CASE A.—RESULTS OF *B. COLI* TESTS IN DILUTIONS INDICATED.

Oysters	1.0 cc.	0.1 cc.	0.01 cc.	Numerical Value
1	+	+	0	10
2	+	+	0	10
3	+	+	0	10
4	+	0	0	10
5	+	+	+	10
			Score	50

CASE B.—RESULTS OF *B. COLI* TESTS IN DILUTIONS INDICATED.

Oysters	1.0 cc.	0.1 cc.	0.01 cc.	Numerical Value
1	+	+	+	10
2	+	+	+	10
3	+	0	0	1
4	0	0	0	1
5	0	0	0	1
				Score, 23

CASE C.—RESULTS OF *B. COLI* TESTS IN DILUTIONS INDICATED.

Oysters	1.0 cc.	0.1 cc.	0.01 cc.	Numerical Value
1	+	+	0	10
2	+	+	0	10
3	+	+	+	100
4	+	+	+	10
5	+	0	0	10
				Score, 140

The committee also suggests that the results of bacteriological examinations in the case of shucked stock be expressed by a similar numerical system, but that only three portions be tested.

The following tabulations illustrates the method as applied to shucked stock.

RESULTS OF *B. COLI* TESTS FOR DILUTIONS INDICATED.

Inoculations	1.0 cc.	0.1 cc.	0.01 cc.	0.001 cc.	0.0001 cc.	Numerical Value
1	+	+	+	+	0	1000
2	+	+	+	0	0	100
3	+	+	+	0	0	100
						Score, 1200

RESULTS OF *B. COLI* TESTS FOR DILUTIONS INDICATED.

Inoculations	1.0 cc.	0.1 cc.	0.01 cc.	0.001 cc.	0.0001 cc.	Numerical Value
1	+	+	+	+	+	1000
2	+	+	+	0	0	1000
3	+	+	+	0	0	100
						Score, 2100

It is thought unwise to assign any sanitary significance to particular scores for *B. coli* until the committee has secured more data than it now possesses. It is hoped that enough information may be obtained before another year to make this possible.

In conclusion, your committee wishes to express its appreciation of the kind assistance of many of the members of the American Public Health Association, and wishes also to commend the attitude which the oyster growers of the country are gradually coming to assume in regard to the sanitary questions involved in their business, an attitude of co-operation with health authorities, instead of one of hostility.

Respectfully submitted,

GEORGE C. WHIPPLE, *Chairman.*
A. W. FREEMAN.
STEPHEN DE M. GAGE.
WILLIAM ROYAL STOKES.
H. D. PEASE, *Secretary.*

PRACTICAL TESTS OF CERTAIN FACTORS IN STATE WORK AFFECTING THE ACCURACY OF DIPHTHERIA CULTURE DIAGNOSIS.*

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Laboratory Division of the Minnesota State Board of Health.

Previous to April 22, 1910, the Laboratory Division of the Minnesota State Board of Health was compelled to submit to the excessive charges and unnecessary delay in delivery of diphtheria outfits by express, because the postal regulation limiting the size and capacity of the serum tube, practically prohibited the mailing of outfits containing serum culture media.

Our experiments with many different styles of mailing outfits containing swabs alone, indicated that their use in routine state work would sacrifice accuracy in bacterial diagnosis. Indeed, Minnesota's experience with swab specimens had led to printing in heavy type on the back of every diphtheria report dating from 1896: "A NEGATIVE DIAGNOSIS IS NEVER MADE ON A SPECIMEN SENT IN ANY OTHER WAY THAN ON FRESH CULTURE MEDIUM."

The Boston Board of Health laboratory staff, after testing the longevity of diphtheria bacilli on swabs, concluded† that laboratory inoculation of serum from swabs forwarded by physicians would give more accurate results in state work than the present method of bedside inoculation. These tests did not cover all the points which necessarily affect routine work in Minnesota, and work was at once begun here to determine whether the efficiency of the laboratory service could be increased by such use of swabs alone. In order to include all factors, and the influence of their variations, such as time in transit, locality, technique, temperature, humidity, personal equation, day of disease, clinical character of cases, etc., in a large way and thereby insure practical reliability in our deductions from the results, our work was planned in three parts.

The work of the first and second parts outlined in this paper extended from November 15, 1909, to May 1, 1910. Ordinary routine specimens were used without selection. Altogether 1270 swabs were tested; these were taken from 874 patients by 302 physicians and forwarded by express, mail or messenger, from 165 different localities in Minnesota. From each of these swabs a bedside and a laboratory culture were sown and the results compared. Of the 874 cases, the laboratory reported 417 positive,

* Read before the Laboratory Section of the American Public Health Association, Milwaukee, September, 1910.

† Am. Jour. Pub. Hygiene, Vol. 5, p. 324.

429 negative, and on 28 reserved opinion, requesting other specimens which were, however, not forwarded.

The personal equation within the laboratory was eliminated as far as possible, the work having been done by three bacteriologists.* Neither the character of the case nor the reason for the examination was known to the examiner before the microscopic diagnosis had been recorded. The number of different physicians (302) taking the swabs would seem to cover the average range of influence due to the personal equation element on the part of the clinician.

The number of specimens (1270) and of patients (874) would seem to allow for the variation in clinical character of cases, amount of membrane or exudate and similar factors, the influence of antiseptic or other local treatment.

The different localities represented (165) would seem to include whatever variation there may be in local conditions likely to affect the viability or morphology of diphtheria bacilli.

The hours which elapsed between bedside and laboratory inoculation vary sufficiently to cover the extremes met with in state work in Minnesota. All conditions peculiar to the usual modes of transit, (express, mail, and messenger,) were encountered.

To determine accurately the influence of temperature and humidity, it would be necessary to follow every specimen from patient to laboratory—an obvious impossibility; therefore, we recognize and accept as inevitable that considerable variation of temperature not necessarily related to the weather must occur in state work. The variations in temperature and humidity, as shown by the reports of the U. S. Weather Bureau, appear to have exceeded the averages for the months concerned. These reports are quoted briefly as a basis for speculation upon the influence of temperature and precipitation which occurred in Minnesota while this work was being done.

A variation in laboratory technique was planned for each part of the work to give every opportunity for detecting the diphtheria bacilli.

The great majority of specimens included in our experiments were from cases which had many previous or subsequent examinations. These afford a good check on case diagnosis. A comparison of the physician's case diagnosis with the laboratory case diagnosis, based upon the examination of more than one specimen from each case, shows the following interesting points which strongly indicate that our work covered the average of state routine:

* Miss Phebe Pearsall, Dr. O. McDaniel, and the writer.

First; 30 cases, diagnosed by the physician as clinical diphtheria; would have been quarantined when diphtheria bacilli were not the cause of the sore throats.

Second; 20 cases, diagnosed by the physician as suspected diphtheria; might have been subjected to unnecessary quarantine had no microscopic examination for diphtheria bacilli been made.

Third; 10 diphtheria convalescents, judged upon clinical opinion alone, would have been released from quarantine with virulent organisms present in their throats.

Fourth; Among the 874 individuals examined were 11 carriers, or about 1.25% who never had clinical symptoms. This percentage approximates the conservative estimate for diphtheria carriers among well persons.

The first part of our work is a comparison of the microscopic findings on serum inoculated at the bedside by the physician with those on serum inoculated in the laboratory from the same swabs. The swabs* were returned to the swab tubes after each inoculation and before incubation. A platinum loop was used in making the microscopic preparations. This technique was used for 635 swabs taken from 440 patients by 187 physicians in 118 localities.

The second part of our work is similar as to the comparison of results, but the swabs were left during incubation upon the serum inoculated by the laboratory workers. The microscopic preparations were made by rubbing the swabs over the surface of the serum and employing them instead of the loop in making the smears. This techinque was used for 635 swabs taken from 434 patients by 190 physicians in 116 localities.

The results of the two techniques correspond so closely that a separate analysis of each is not necessary. The table given affords opportunity for detailed observation and comparison.

NO ATTEMPT HAS BEEN MADE TO INCLUDE IN THIS PAPER THE ANALYSIS OF SUCH RESULTS—813 SWABS—AS WERE UNIFORM IN BOTH BEDSIDE AND LABORATORY CULTURES.

Altogether nearly 36% (457) of the total number of 1270 laboratory cultures failed to check with those previously inoculated at the bedside from the same swabs. These 457 swabs were taken from 318 patients by 175 physicians, and were forwarded from 114 different localities in Minnesota,—407 by express, 29 by mail, and 21 by messenger. The number of hours between bedside and laboratory inoculation of the same swabs, herein designated as time in transit, varied from 2 to 171† hours,

* Wooden applicators are used in Minnesota state work.

† One specimen, carelessly overlooked by the express agent, was forwarded from Brainerd, Minnesota, via Seattle, Washington.

although 443 were received within 84 hours; and the date and hour of bedside inoculation of six specimens were unknown. No data were available for calculating the day of disease on which 74 specimens were taken, but 360 specimens were taken on or before the 38th day and 23 later than the 38th day.

Nearly 95% of the discrepancy was apparently due to changes which occurred in the swabs after application to the throats and before inoculation in the laboratory. Unsatisfactory growth, however, caused 54% of all the discrepancy. This resulted from the failure of the physician to use the swab as directed and FROM LOSS OF MOISTURE DURING TRANSIT. The faulty technique of the clinician, as a matter of fact, lowers the efficiency of the immediate bedside inoculation method about three per cent.

Extreme carelessness on the part of physicians is clearly shown by observations in nine swabs excluded from this analysis which gave no growth in either the bedside serum or on later inoculation of another serum in the laboratory. Thirty original serums gave no growth, because they were not inoculated by the physician at the bedside; the swabs received with them yielded satisfactory growth upon inoculation of the laboratory serum. Later each of these original serums was sown in the laboratory from the swab sent by the physician and developed a growth, which proves that it had not been inoculated at the bedside.

Far more accurate results were obtained by the present serum method of immediate bedside inoculation than by the proposed swab method of deferred laboratory inoculation.

Of the 457 specimens which indicated results on laboratory inoculation different from that of bedside inoculation, 203 were sent for bacterial diagnosis from 193 cases, with clinical diagnosis as follows. "Diphtheria" 93, "Suspicious" 45, "Exposed" 16, and "No disease" 39. Most of the diagnosis specimens were taken on or before the seventh day of the disease. The remaining 254 specimens, sent for release from quarantine, were from 121 clinical cases and from 4 suspicious cases. The release specimens were distributed from the 6th to the 41st day of the disease, except a very few taken later.

Classifying the 227 bedside serum positives according to hours in transit, the deteriorating influence of time and dessication is shown, since of 75 swabs received within the first 24 hours after bedside inoculation only 17 (22%) showed even suspicious bacilli upon laboratory inoculation; of 100 received in the second 24 hours only 17 (17)% showed even suspicious bacilli; of 37 received in the third 24 hours only 6 (16%) showed even sus-

picious bacilli, and of 15 received later than 72 hours only 1 (6%) showed even suspicious bacilli.

The positive granular types of diphtheria bacilli were found in these 227 bedside cultures, while the 41 (18%) laboratory cultures classed as suspicious displayed only barred or solid types; 109 (48%) showed no diphtheria-like bacilli; and in 77 (34%) no bacteriological diagnosis could be given on account of unsatisfactory growth.

The analysis and tabulation of this work was very thorough and laborious. Every factor concerned was carefully studied to determine accurately its influence, but on account of the expense of publication, complete tables, covering 21 typewritten pages are omitted* and only the headings are outlined to show the extent of the investigation.

Table "A" recorded the serial number of the specimens, the day of disease when taken, whether taken for diagnosis or release, how transmitted to the laboratory,—by express, mail or messenger—the exact number of hours in transit. Under the heading, "microscopic findings on serum inoculated at bedside and in the laboratory," were given the types of diphtheria bacilli and the associated organisms, and under the heading, "case diagnosis," the physician's and the laboratory diagnosis.

In "Table B" the specimens sent for diagnosis and for release in each part of the work were enumerated separately in twelve-hour groups, according to the time taken in transit, on the basis of the diagnosis given from microscopic findings, as follows:—Positive; Negative; Reserved on account of (a) suspicious bacilli (b) scant or no growth (c) dry serum (d) serum liquified by spore bacilli or pasty growth.

The physician's case diagnosis (Positive, Suspicious, Exposed, No Disease) with the laboratory case diagnosis (Positive, Suspicious, Reserved, Negative), was also shown in Table "B".

In Table "C" a comparison of the respective case diagnoses of physician and laboratory† was made, the specimens for diagnosis and release of the first and second techniques being enumerated under the headings "Both Positive"; "Both Negative"; "Both Reserved"; "Phy. Positive, Lab. Negative"; "Phy. Positive, Lab. Suspicious"; "Phy. Negative, Lab. Positive"; "Phy. Negative, Lab. Suspicious"; "Phy. Suspicious, Lab. Positive"; "Phy. Suspicious, Lab. Negative"; "Phy. Exposed, Lab. Positive"; "Phy. Exposed, Lab. Suspicious"; "Phy. Exposed, Lab. Negative"; "Phy. No Disease, Lab. Positive"; "Phy. No Disease, Lab. Negative"; "Phy. No Disease, Lab. Suspicious."

* By permission of Dr. F. F. Wesbrook, Director of the Laboratory Division.
† Based upon findings of bedside cultures.

Table "D" enumerated the diagnosis and release specimens of each of the two parts of the work under the day of disease on which the swabs were taken.

Table "E" enumerated the diagnosis and release specimens of each part according to the number of hours which elapsed between bedside inoculation and laboratory inoculation of the same swabs, .i. e., 1-12 hours, 12-24 hours, etc.

Table "F" is given in full (p. 589), since it shows just how the 457 laboratory inoculations differed from the bedside inoculations of the same swabs.

This work demonstrates the following facts:

95% of the total error was due to the *swab method*.

2½% of the total error was due to the physician's faulty technique.

2½% of the total error was due to uncontrollable factors, such as the development of bacteria resulting in pasty growth or liquefaction of serum, the use, contrary to printed directions, of worthless culture outfits in which the serum was completely dried, the physician's occasional neglect to swab the throat after he had filled out the data blank, and errors in bacterial diagnosis, which must be almost *nil* under the excessive precautions taken in this work.

To compare in absolute figures the accuracy of the two methods, let each specimen count as one point. Then the proposed swab method of deferred laboratory inoculation has to its credit 842 points, or 64% of accuracy in results.

813 (results alike by both methods).
9 (positive by *swab*, negative by *bedside method*).
20 (20 to 30 bedside serums showing no growth*).

against 1231, or 97% of accuracy in results, for the present *serum method* of immediate bedside inoculation.

1270 less 39 (9 specimens negative by *bedside*, positive by *swab method*).
(30 specimens no growth by *bedside*, satisfactory by *swab method*).

Certain factors should be considered in connection with this investigation. The range of temperature over which the viability of diphtheria bacilli extends is known from experiments with pure cultures, and the extremes of temperature likely to be encountered under the usual conditions of culture transportation fall well within this range. Our results fully bear this out.

Drying tests, which diphtheria bacilli in pure culture have survived, show a rather small downward range of humidity; although throat swabs

* Assuming that the same proportion of these laboratory inoculations was correct as of the whole number, i. e., 813 in 1270, or about two-thirds.

kept for a long time in cotton-plugged tubes without exposure to sunlight have given good growth of diphtheria bacilli. As a rule, swab tubes are plugged tightly and not exposed to sunlight during transit. Assuming that our swabs were dipped in the water of condensation during the inoculation of the bedside culture, they may have retained more moisture after the drying during transit than would swabs moistened only by swabbing throats and used for sowing serum after reaching the laboratory. Assuming also that some part of the infectious material gathered by throat swabbing is deposited on the bedside serum, there may have been remaining on our swabs less throat material for the second inoculation than would remain on swabs first applied to serum in the laboratory; however, the throat material on our swabs would have been unaffected, except that the vitality of the organisms may have been conserved during transit by the additional moisture and nutrient medium acquired by the swab when rubbed over the moist serum at the bedside.

We conclude from the data presented that high temperature tends to increase error only as it promotes drying of the swabs, and that the chief cause of error is not the variation of temperature encountered in transit, but the LOSS OF MOISTURE FROM THE SWABS.

The third part of the work was planned to be a test of the relative efficiency of bedside and laboratory inoculation of swabs, exactly comparable in every particular. It was deferred until our new mailing outfits for diphtheria specimens could be distributed throughout the state.

Two tubes of serum for separate nose and throat bedside inoculation, and two tubes, each containing two swabs, are to comprise the outfit. The physician will inoculate the serum, by the use of separate swabs for nose and throat, leaving the swabs in the serum tubes. The other two swabs, after application to the nose and throat, are to be sent back to the laboratory, in separate tubes labelled "nose" and "throat," to be used there to inoculate serum which will be incubated and examined at the same time as the bedside serums. The results from 1000 such specimens should be sufficient finally to decide this question of bedside vs. laboratory inoculation of swabs in routine state work.

TABLE F.

SHOWING HOW THE 457 LABORATORY INOCULATIONS DIFFERED FROM THE BEDSIDE INOCULATIONS OF THE SAME SWABS.

Bedside Inoculations		Same swabs inoculated in laboratory.				
Diagnosis on Microscopic findings.		Positive	Negative	Reserved on account of		
				Susp. bacilli	No growth	Spore bacilli
Total positive, 227						
Technique No. 1....	114		61	14	38	1
Technique No. 2....	113		48	27	29	9
Total negative, 182						
Technique No. 1....	93	5		6	81	1
Technique No. 2....	89	4		1	76	8
Total reserved, 48						
Technique No. 1....	31					
Techinque No. 2....	17					
(a) Susp. Bac., 13						
Technique No. 1....	4	2			2	
Technique No. 2....	9	2	4		3	
(b) No growth, 30						
Techinque No. 1....	25	2	21	2		
Technique No. 2....	5	2	3			
(c) Serum spoiled, 5						
Technique No. 1....	2		2			
Technique No. 2....	3		3			
	457	17	142	50	229	19

227 swabs showing granular types of *B. diphtheriae* on bedside inoculation gave different results on deferred laboratory inoculation, as follows:

109 showed no diphtheria-like bacilli.
77 showed unsatisfactory growth.
41 showed suspicious bacilli (barred and solid types only).

182 swabs showing no diphtheria bacilli on bedside inoculation gave different results on deferred laboratory inoculation, as follows:

9 showed granular types of *B. diphtheriae*.
166 showed unsatisfactory growth.
7 showed suspicious bacilli (barred and solid types only).

EXTRACTS FROM REPORTS OF U. S. WEATHER BUREAU.

REPORT FOR NOVEMBER, 1909:

"In Minnesota the mean temperatures ranged from a little above 38° to somewhat less than 28°. Unusually cold periods extended from the 15th to the 18th, and from the 22nd to the 23rd. The 18th was generally the coldest day.

"The precipitation ranged from nearly 8 inches to a little more than one-fourth of an inch. The bulk of the precipitation fell between the 13th and the 16th. There was an unusually heavy fall of snow in the western counties on the 14th, and over the greater portion of the State on the 16th. The monthly snowfall was unusually heavy ranging from about 3 inches in the central counties to 30 inches in the south, and to 20 inches in the north."

REPORT FOR DECEMBER, 1909:

"Warm weather prevailed from the 1st to the 5th, followed by steady cold weather the rest of the month. The 1st was generally the warmest day and the 29th the coldest. The highest temperature recorded was 58° on the 2d, and the lowest 39° below zero, on the 9th.

"The precipitation was the heaviest on record with the single exception of December, 1902. The average for the past month was 1.52 inches. Quite general rains fell on the first 4 days, followed by general and heavy snowfall on the 5th. General and more or less heavy snows fell on the 11th, 16th, 20th and 27th. The snowfall was unusually heavy. The ground was covered from the 5th to the end of the month to a depth of 5 to 15 inches."

REPORT FOR JANUARY, 1910.

"The month was considerably warmer than usual in Minnesota, although an unusually cold period extended from the 3d to the 10th. The first 2 or 3 days were moderate but after the 3d a cold wave spread over the section, and markedly low temperatures prevailed until the 10th; zero temperatures were recorded on several days, and ranged from —2° to —17° on the 6th and 7th. After the 15th the weather moderated somewhat, with several bright and pleasant days during the third and fourth weeks, but the maximum temperature was below 50°, except on a few days.

"The average precipitation was slightly above the normal, but there was a deficiency in northern Minnesota. More or less general storms occurred on the 5th, 17th, 20th and 26th. The snowfall ranged from 1 to 15 inches, and the ground was covered with snow throughout the month from 5 to 20 inches in depth."

REPORT FOR FEBRUARY, 1910:

"There was a deficiency of temperature of 3° to 5° per day, the mean for the month being 6.2° lower than in February, 1909, and 5.2° warmer than the coldest February, that of 1904. The deficiency of temperature was general. An unusually cold period extended from the 15th to the 25th.

"The precipitation ranged from one-tenth of an inch, or less, to over an inch in a wide belt extending across the center of the State from Bigstone, Traverse, and Chippewa counties to Lake Superior. The deficiency of precipitation was general, except within this belt. The heaviest storm of the month occurred on the 15th. The snowfall was unusually light, but a very unusual depth of old snow remained on the ground throughout the month."

REPORT FOR MARCH, 1910.

"In Minnesota the month was remarkably warm, dry, and sunshiny. In fact, it was by far the warmest, driest, and clearest March on record. The mean temperature ranged from about 44° in the southern counties, to about 36° on the international boundary. The excess in temperature ranged from 14° in the east, to 18° above the normal in the western part of the State. The 23d was the warmest day, and the coldest days occurred between the 7th and 9th. The temperatures on the 23d were the highest ever recorded in the State in March as shown by various records, extending back 10 to 88 years.

"The precipitation was practically inappreciable over the southern half of the State, and was below the normal in all but the extreme northwestern corner, where some of the monthly amounts were in excess of an inch. The greatest 24-hour precipitation occurred generally on the 29th and 30th. On those dates there were thunderstorms, confined mainly to the western and northern counties."

REPORT FOR APRIL, 1910.

"The month was much warmer than usual in Minnesota. Unusually warm periods occurred on the 9th and 10th and on the 27th and 28th. On the last date a maximum of 95° was recorded at Winnebago and Lynd No. 2, which is the highest temperature ever recorded in the State during the month of April. Cold periods occurred on the 16th and 17th and from the 22d to the 25th, with severe freezing temperatures, greatly damaging vegetation, which had prematurely advanced during the warm weather of March and the first half of April.

"The precipitation was generally below the normal, but an excess occurred in portions of Minnesota. The precipitation ranged from a little more than one-half inch to more than 4.00 inches. There was an excess of precipitation in most of the western and northern counties, and a deficiency in the eastern and southern counties. Most of the monthly precipitation occurred from the 14th to the 18th, but there was quite general precipitation on the 4th and 22d. On the 16th and 17th there was a general and heavy fall of snow. The average monthly snowfall was 4.5 inches."

Section on Vital Statistics

REPORT OF THE COMMITTEE ON UNIFORM TABLES FOR STATISTICAL REPORTS AND BULLETINS.*

The committee appointed to co-operate with a corresponding committee of the American Statistical Association and with the Bureau of the Census, begs leave to submit the accompanying memorandum on uniform tables as its report of progress, with the request that such of the specific recommendations as may seem advisable be adopted as rules of statistical practice.

The co-operating committee of the American Statistical Association, through its Chairman, Professor Walter F. Willcox, presents a draft of a report of that Association, with forms of tables, which is incorporated in this report, subject to any amendments or alterations that may be made, prior to its adoption, by the American Statistical Association.

There is also appended to this report a circular letter issued by the Bureau of the Census, and it is urged that the report be published, if feasible, perhaps as a census pamphlet, as a basis upon which definitive recommendations and forms of tables may be presented for adoption at the next session of the Association.

The problems involved are so far-reaching and difficult in their practical solution that it would seem necessary to proceed slowly and cautiously rather than to exhibit undue haste in the formulation of proposed forms.

Respectfully submitted,

WM. C. WOODWARD,
MARSHALL LANGTON PRICE,
CHAS. A. HODGETTS,
F. L. WATKINS,
Committee.

* Read before the Section on Vital Statistics of the American Public Health Association, Milwaukee, September, 1910.

REPORT OF THE COMMITTEE OF THE AMERICAN STATISTICAL ASSOCIATION.

The undersigned members of a committee appointed at the last annual meeting of this Association to co-operate with a committee of the American Public Health Association to consider forms of tables employed in registration reports, federal, state, and municipal, and to draft a set of standard tables, have the honor to submit the following report of progress:

The form of statistical tables is dependent primarily upon the information which the tables are to convey; that information always consists in certain statistical totals correlated in various ways. In American registration reports, as a class, the space given to tables regarding deaths greatly exceeds that given to all other tables combined. For this reason the present report is confined to mortality tables.

American registration of deaths in nearly all cases is now based upon a standard certificate. Hence the information open to tabulation is practically identical. Part of the information conveyed on a certificate is merely for identification or corroboration and has no statistical value. This is true regarding the decedent's name and that of the father and mother, the date of birth as distinguished from the age, the length of residence, the place and date of burial, and the name and address of the undertaker. After excluding these items, there remain for use in statistical tabulation the following:

(1) Place of death,
(2) Time of death,
as physical characteristics of the decedent.
(3) Sex.
(4) Age.
(5) Race or color.
(6) Birthplace.
(7) Birthplace of father.
(8) Birthplace of mother.
(9) The cause of death,
as social or economic characteristics of the decedent.
(10) Marital condition.
(11) Occupation.

The cases or deaths are thus susceptible of classification under each of these heads, and each possible combination of them, and the living population as reported by a census or as estimated for other than census years, may be similarly classified. The proper classification of deaths is the primary object of all mortality tables in registration reports, the presentation of ratios between the annual deaths in a certain group, and the enumerated or estimated living population in that group is the secondary object.

The classification of deaths should run parallel with, and not extend beyond, that of the living population. For example, there would be little or no use in so classifying deaths as to ascertain the deaths of natives whose mothers were born abroad, so long as the corresponding class in the living population is unknown.

Tabulations with reference to a single characteristic seldom, if ever, have much scientific or practical value. Thus to know the number of females who died in 1910 or the number of persons who died of tuberculosis is of little importance. But when

the persons dying of tuberculosis are classified by sex, age, and occupation, and the living population is classified in the same way, and the ratios or rates computed, the results become significant. There is little use, then, in tabulating separately for each of the eleven characteristics previously mentioned; the tables should merely show various combinations of these eleven characteristics. These combinations may be dual-like sex and nativity; triple-like sex, age, and occupation; quadruple-like sex, age, occupation, and cause of death; and so on.

The problem of the forms of tables in registration reports is in no slight degree a mechanical one, inseparably connected with the size of the printed page, the amount of space, and of money available for the work, etc. Answers to problems of this sort must be left to the authorities whose official duty it is to deal with them. The particular aspect of this problem with which a committee of private students can properly deal, is with reference to the best correlations of statistical data to be incorporated in those tables. If a list of desirable correlations, arranged in the order of their importance, could be made out, the work of the committee might be deemed properly completed.

In drawing up such a list, it is possible either to start with the present procedure and attempt to systematize it, or to disregard that experience and start afresh. Your committee believes that the former is the proper method and has therefore inquired; What correlations of statistical data are now presented? To secure an answer to this question the latest available registration reports of every registration state and of ten registration cities, selected on the basis of size and location, have been examined. New York and South Dakota were disregarded, because of the almost complete absence of classification of deaths in their reports. The District of Columbia is treated as a state rather than as a city. In this way a total of sixteen registration states is found; of these sixteen the number which tabulate the several items is as follows:

Item	Number of registration states in which it is tabulated.
Place of death	16
Cause of death	14
Sex	7
Age	7
Time of death (month)	6
Birthplace (native or foreign born)	4
Race or color	2
Nativity of parents	1
Marital condition	1
Occupation	1

The number of possible correlations of two items in a series of eleven, by a simple mathematical formula is found to be fifty-five. Of these fifty-five possible correlations, the following are those found most commonly in the sixteen registration states:

Correlation	Number of registration states in which it is tabulated.
Cause and place of death	13
Sex and cause of death	10
Sex and place of death	10
Age and cause of death	10
Time and cause of death	9
Sex and age	8
Place of death and nativity	7
Age and place of death	7
Place of death and color	5

Of the fifty-five possible correlations of two items, nine are found in at least five states, eleven are found in from one to four states, and thirty-five are not found in any state. As examples of possible classifications of deaths not now made in any registration state, the following may be mentioned: A classification by sex and occupation, by sex and marital condition, by age and nativity, by occupation and race.

An examination of the tabulations made in the health reports of the ten selected cities does not show any significant difference between the state and the city forms.

Your committee recommends, then, that all states and cities not now giving this information be urged, if possible, so to modify their tables as to include in them such dual classifications as are already furnished by more than one-third of the registration states—namely:

Sex and age	Place and cause
Place and sex	Cause and sex
Place and age	Cause and age
Place and nativity	Cause and time

The committee also recommends that all states and cities having more than ten per cent. of negroes in their population tabulate also by place and color.

In a series of eleven items the number of possible correlations by threes is 165, or three times the possible number of two correlations; the number of possible correlations of four items is 330. But the labor and cost of tabulating by threes and by fours are far greater than those required for two items. It is not surprising, therefore, to find, that while of the fifty-five possible correlations by twos, twenty, or thirty-six per cent., are found in at least one state; of the one hundred and sixty-five possible correlations of three items only twenty-five, or fifteen per cent., are found in at least ode state, and of the three hundred and thirty possible correlations of four items only ten, or three per cent., are found in even one state, and only one is found in two states. Having in mind this omission of complicated tabulation by American states and cities at the present time, and also the difficulty and cost of introducing them, your committee does not recommend any material extension of the work of municipal and state departments into these now unoccupied fields. It suggests, indeed, that these fields are just the ones in which the Federal government, acting through the Bureau of the Census, may best aid city and state health work by preparing such complicated and expensive tables for the registration area and its leading divisions.

To make its recommendations more specific and thus, perhaps, more helpful, it submits the following drafts of tables:

Table 1 gives the population of each division of the state or city for the last two censuses and the population for the year in question, as estimated by whatever method has been adopted as the best.

Table 2 gives the deaths for each state or city and recognized subdivision by sex, by time (month of death), and by age.

Table 2 thus gives the correlation of place and sex, place and time, place and age, or three of the eight correlations recommended by your committee.

Table 3 would be a brief table having in the stub the same age classes as appear in the box heads of Table 2 and in the box heads simply "Total Male—Female." This affords the correlation for age and sex.

Table 4 would give the correlation of place and nativity, and, if that were desired, place and color. Where the proportion of negroes was so slight as to make the correlation of place and color unimportant, the distinction between native and foreign

born is so significant that it might be wise to correlate place with nativity of parents. This would give two forms of the table with identical stubs, but with varying box heads, as shown below:

TABLE 4—Deaths Classified by nativity and parent nativity.

Deaths classified by nativity.

Place of death	Native				Foreign Born
	Total	Total	Of Native Parentage	Of Foreign Born Parentage	

TABLE 4a—Deaths Classified by Nativity and Color.

Deaths classified by

Place of death	Nativity			Color		Other
	Total	Native	Foreign Born	White	Negro	

Table 5 would give the cause of death in the stub, and in the box heads the sex classification and the counties or tracts into which the reporting area was divided. This table would thus present the other two correlations, cause and sex, and the cause and place, as indicated below:

TABLE 5—Deaths Classified by Sex and Cause of Death for Counties (or Tracts).

Deaths Classified by

Cause of Death	Sex			County of death					
	Total	Male	Female	A	B	C	D	E	F

The preceding five tables include all of the correlations of two items now presented in any five of the registration states and thus may be regarded as a sort of codification of prevailing practice in American states and cities.

Regarding the municipal areas to be accepted as units for tabulation, your committee reports that the frequent and important changes in the boundaries of municipal voting districts like wards and precincts, the absence of any other legal divisions of permanence and importance, and the great difficulties in the way of tabulating by blocks, have led the Census Bureau in a few of the largest cities to define permanent artificial areas of about forty acres to be used for tabulating purposes and to contemplate a gradual extension of this system. Your committee invites the attention of municipal registrars to this plan and suggests that these areas be carefully considered for purposes also of local tabulation.

MEMORANDA ON UNIFORM TABLES FOR VITAL STATISTICS.

1. It is more expedient to discuss the general question of securing uniformity and to agree upon some general principles than it is to adopt at this time any actual forms of standard tables.

2. Standard tables should be considered with reference to their appropriateness for, first, the census reports; second, state reports and bulletins; third, city reports and bulletins.

3. Census reports should deal primarily with states and large cities, giving only the fundamental data for small cities and counties. They should deal with data in the mass, for broad comparisons chiefly, and to establish standards (e. g., corrected rates, general life tables) with which local comparisons can be made.

4. State reports should begin where the census reports leave off, and study the state as a unit; and they should give special attention to counties and groups of counties (e. g., see Bulletins of Indiana, Michigan, and New York), and should present data in considerable detail for small cities and villages, singly and grouped into cities of from 5,000 to 10,000 population, etc. They may even take up the individual towns or townships when such units are important, but they should not go into the subdivisions of large cities that maintain an efficient registration service.

5. City reports, especially those of large cities, should deal with the primary units of area (city blocks) grouped into such larger aggregates (wards or sanitary districts) as may be found advisable, and they should specialize on morbidity statistics and their relation to mortality statistics.

6. Whatever mortality statistics are worth printing at all are, as a rule, worth printing with full details of sex, age, and color (when colored population is ten or more per cent.) This refers to the primary tables.

7. "Unknowns" should never be "distributed" but should appear as a criterion of registrative efficiency for sex, age, color, and all other items.

8. Important general tables, and especially those for causes of death, should show ages, by sex, for each quinquennial period from 0-4 to 95-99. The first quinquennial period should be subdivided into single years. A detailed list of centenarians should be given, and for infant mortality the first year of life should be stated by months, the first month by weeks, and the first week should show at least the first five days individually. For tables of occupations the periods should be: 10-14, 15-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85 and over, with special statement for children under ten years, when child workers under that age are found.

9. All main tables of causes of death in reports of states and large cities should use the detailed International Classification without change or alteration, except that SUBDIVISIONS (but not additions or changes) of titles may be made when necessary. For minor tables the exact abridged International Classification should be used in the same way, and for special purposes shorter selected lists may be made, each title representing certain definite titles of the detailed International Classification. Each title should bear its International Classification number to assure ease of comparison and certainty in regard to the inclusion of terms.

10. For the following diseases tables should be presented by calendar months and by the regular series of age periods until less than five per cent. may be embraced in the final period:

Typhoid fever	Tuberculosis
Malarial fever	Bronchitis
Measles	Pneumonia
Scarlet fever	Diarrhea and enteritis
Whooping cough	By months, weeks, and days of age.
Diphtheria and croup	Congenital debility, etc.
Influenza	By months, weeks, and days of age.

11. Causes of death with death rates should be presented for each year since the beginning of registration, if practicable according to the abridged International Classification, otherwise according to the list in the International Table of the Registrar-General's Report.

12. The first general tables constructed should provide for the data contained in the main tables of the International statistics of the "*Statistique Generale*" of France.

13. Every report should contain a table showing the dates and population, by sex and ages, at several recent censuses.

14. Every report should contain a table showing the elements of population, by sex, age, color, nativity, etc., at the last census.

CIRCULAR LETTER OF THE BUREAU OF CENSUS.

DEAR SIR: One of the most important questions that concerns all who make and use vital statistics reports and bulletins is: How shall the data be presented in the most serviceable and readily comparable form?

The solution of this problem requires co-operation. A special committee of the American Public Health Association's Section on Vital Statistics (Dr. W. C. Woodward, Washington, D. C., Chairman) and a co-operating committee of the American Statistical Association (Prof. Walter F. Willcox, Ithaca, N. Y., Chairman) are co-operating with the Bureau of the Census for the purpose of preparing uniform standard tables for the presentation of vital statistics.

All reports on vital statistics—national, state, and municipal—should be thoroughly co-ordinated, so that unnecessary duplication of work can be avoided and desired data can be readily found in comparable form.

With reference to the last census report I should like to ask:

(1) Whether it fairly meets requirements for such a publication? If not, in what respects is it chiefly lacking?

(2) What tables could be omitted without material loss? Why?

(3) What tables should be added?

(4) What tables should be changed in form in order to be of greater use?

(5) Other suggestions or criticisms.

The time is now at hand for beginning the Annual Mortality Reports of the Census Bureau for a new decade—1910-1919—and we are in a position to secure action along uniform lines for co-ordinating the national, state, and city reports so that each may come to recognize more clearly its own field of special usefulness. I shall appreciate the greatest frankness and shall take pleasure in submitting all suggestions to the co-operating committees, who join me in this request.

Very respectfully,

CRESSY L. WILBUR, M. D., Chief Statistician.

Notes and Reviews*

PUBLIC HEALTH NEWS AND NOTES.

B. L. ARMS, M. D.,
Director of the Board of Health Laboratory, Boston, Mass.
(*Reviewer.*)

†**Abolition of the Common Towel in Kansas.** By a ruling of the State Board of Health the use of the common roller towel in hotels, railway stations, and in public and private schools is prohibited from and after September 1, 1911. The term "common towel" is construed to mean roller towels and towels intended or available for common use by more than one person without being laundered after such use.

Recent Health Measures in Michigan. Under the orders of the Secretary of the State Board of Health of Michigan: (a) An exhibition health train will be run through the southern section of Michigan during the first half of August, 1911. This train will be equipped with a large collection of charts and models, and demonstrations will be made. (b) A pamphlet has been prepared to be used by the teachers in the public schools as an instruction manual in making physical examination of children, with especial reference to defective conditions of the eyes, ears, nose, teeth, mouth and throat. (c) On and after July 20, 1911, the resolution forbidding the use of a common drinking cup in railroad trains, steamships, depots and schools, will be enforced. (d) An expert in the study of eugenics will be employed to make a careful study along that line. (e) A permanent educational committee is to be appointed to plan, arrange and hold sanitary institutes, and to engage lecturer in the interests of preventive medicine. It is planned to hold ten state sanitary conventions at various points during the coming winter. (f) A weekly bulletin is to be published by the secretary. (g) Provision is to be made for a medical inspector to work in association with the Dairy and Food Department in the investigation of water, milk, and other food supplies.

*EDITOR'S NOTE. Readers are urged to send public health notes of interest to the Editor by whom they will be distributed to the proper reviewer. The sender's name or initials should appear under such notes.

†Bulletin of the Kansas State Board of Health, June, 1911.

Resignation of the Secretary of the Ohio State Board of Health. Dr. Probst, for twenty-five years Secretary of the Ohio State Board of Health, has recently tendered his resignation. In an interview given to the "Columbus Dispatch," he gives his reasons as follows: "After mature consideration I have decided to resign as Secretary * * * * because under the present regime I am no longer permitted to direct the work along lines that seem to me of most importance and for the best interests of the state. Furthermore, the recent action of the board in re-electing me its secretary for a term of one year, a thing that was never done before and which is not contemplated under the law, makes the term of office so uncertain that no executive officer, even if unhampered, could count on carrying out broad and definite policies requiring time, which is absolutely essential in public health work. I shall therefore retire and devote my entire time to the practice of medicine."

BOOK REVIEWS.

Proceedings of the American Association of Medical Milk Commissions. Fourth Annual Session, 1910. 266 pages. $1.00. Office of the Secretary, Otto P. Geier, M. D., 124 Garfield Place, Cincinnati, Ohio.

This book contains a very valuable collection of addresses with discussions on the subject of clean milk. Mr. Stephen Francisco, first producer of certified milk in this country, presents a paper on certified milk in a most interesting and instructive manner and the subsequent discussion brings out many of the practical difficulties encountered in certified milk production. Another paper from the dairyman's point of view, by Professor Stocking, of Cornell, is a careful scientific presentation of certified milk problems. The bacteriology of milk and the influences affecting it are gone over from the point of view of the dairy and the laboratory. The relation of bovine to human tuberculosis, especially as it has to do with the transmission of the disease through milk, is summarized in a very clear and concise address. A most interesting statement of the history and development of the milk charities of the United States shows the detailed workings of all these associations and their relation to other charitable organizations in the cities in which they are situated, and their relations to one another and to medical milk commissions.

At the end of the book there is appended a manual of the working methods and standards of medical milk commissions to serve as a basis and guide for commissions. This manual presents the combined experience of all the important medical milk commissions in the United States. It shows the legal status of certified milk work and states the methods of inspection for farms and the standards which should be required. It also lays down standards for the chemical and bacteriological examination of milk.

Altogether it is a very interesting and concise presentation of the subject of clean milk. This book will prove interesting to laymen and to physicians in general, especially to those interested in the clean milk problem. It will be indispensable for members of the medical milk commissions and those working in other organizations intending to improve the quality of the milk supply. RICHARD M. SMITH.

NOTICE TO MEMBERS

OF THE

Massachusetts Association of Boards of Health

According to the contract recently approved by the Executive Committee of the Massachusetts Association of Boards of Health, members of that organization who pay the higher membership rate are entitled to receive, without extra charge, the four issues of this Journal which contain the papers of the regular quarterly meetings of that Association.

Members desiring to receive the remaining eight monthly issues can obtain them at a cost of two dollars a year. Notification should be sent to this office and remittances made payable to the Journal.

Journal of the American Public Health Association,

URBANA, ILL.

American Public Health Association

PAPERS AND REPORTS

The Reports and Papers of the American Public Health Association are a necessary part of every library that undertakes to supply its patrons with reliable information pertaining to the public health. These reports and papers have been published in annual volumes, each year since 1872, and their contents reflect the history of sanitation during that period. As issued, they were sold at $5.00 a volume. Copies of all volumes, except Volume 3, remain in the possession of the Association, and it is desired to place them at once where they will do the most good. With a view to making a prompt distribution, special prices have been fixed, depending upon the recency and scarcity of these volumes, as follows:

Volume	Price	Volume	Price
1	$2.50	19	$1.00
2	1.00	20	2.50
3	....	21	2.50
4	2.50	22	1.00
5	3.50	23	2.50
6	3.50	24	1.00
7	2.50	25	1.00
8	1.00	26	1.00
9	1.00	27	2.50
10	1.00	28	3.50
11	1.00	29	2.50
12	1.00	30	5.00
13	1.00	31	5.00
14	1.00	32	5.00
15	1.00	33	5.00
16	1.00	34	5.00
17	1.00	35	5.00
18	1.00		

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